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CIVIL ENGINEERING.

Canals and Railways in India. An abstract of paper read before the Royal Society of Arts. By W. Bridges Adams.*

In opening the discussion, Mr. Adams deprecated any exclusive leaning to canals or railways, other than for their respective advantages. It was desirable to enclose and cultivate India; and, for the purpose of cultivation, irrigable canals were desirable; but for the purpose of civilization, fast traveling was essential. To assert that no railway ought to be made where water transit exists in a similar direction, would be to determine on a great waste of very valuable time amongst the most intellectual members of the community—a process fatal to the general progress of the masses. In all times and ages, rapid transit—rapid as compared with the general movement of the community—has been found a necessity of government and progress. The ancient Peruvians, lacking the means of mechanical and animal locomotion, established a communication of human runners, at posts a few miles apart, in order to convey messages rapidly. Modern Indians are used as beasts of burden to convey their ruling classes at the rapid rate of four miles an hour, because they find it a necessity to travel faster than bullock-wagons, through districts where water transit exists not, and horses cannot be maintained. It might be said that people ought not to travel at a cost of cruelty, but they do, and they will, in failure of non-cruel methods; and amongst the national cruelties that have been abolished by the advent of railways, that of the cruelty to post-horses is not one of the least; a cruelty, be it

* From the London Artizan, August, 1855.

remembered, not of the poor, but of the rich; a cruelty, not of the race-course or of the hunting-field, but of the road; a cruelty which the legislator, returning from his duties to his estate in the country, indulged in as prominently as other men, when giving an extra half-crown to the post-boy to induce him to give an extra spurring to the bleeding ribs of the jaded post-horse.

Fast traveling must be, to induce civilization, even at the cost of stinted rations to the poor, who have to do the work at the outset, not destructive fast traveling for whims, but traveling as fast as can be accomplished without greatly enhanced cost.

A mechanical difference in the construction of the canal and the railway is this: the former must be a series of direct levels, with sudden drops, in the form of locks; whereas the latter may be a gradual incline. It is obvious that the incline does not increase the cost in making the line, whatever may be the case in working it. But locks and their maintenance do very seriously increase the cost both of making and working.

Canals belong to peculiar localities, such as Holland, where the water is in abundance, and it is almost needful to dig ditches to make dry land. In such districts a canal does not become a mischievous monopoly; but in England, which is by no means a dry climate, the canals were a monopoly, for there was only a given quantity of water, and it was all owned, and could not be increased by manufacture. That also might come to pass in India.

The railway came and beat down the monopoly. Iron is not limited like water; and wherever a railway proprietary charge large fares upon an extravagant capital or a spendthrift working expenditure, there, infallibly, in due time, will parallel lines of rail be laid down. The only way in which a practical railway monopoly could be accomplished in England, would be to purchase two strips of land, east and west, and north and south, in the form of a cross, and charge black-mail to every one passing over it, as the barons did in the olden time, when there were no Acts of Parliament to make individual advantage give way to the public good.

Rivers, to be constant, must be dependent on some process of nature for storing up water. In Chilé and Peru, the Andes perform the office by storing up the snow; but the rivers are little more than a hundred miles in length. In the Upper Ganges, the Himalaya range performs the same office. Mont Blanc and other mountain regions supply the Rhone, which was formerly a navigable river all the year round, while the snows were sheltered beneath the pine forests, and melted gradually. The pine forests being cut down, the Rhone is now an alternate mountain torrent and a non-navigable stream during great part of the year. The proof of this is, that within a few years past Lyons has been subject to periodical inundations, which have washed down dwellings and stores constructed of unburned bricks. It is obvious that such buildings would not have been erected if they had originally been in risk of melting down like barley-sugar. The large American lakes which are drained by the St. Lawrence, and to which the limestone range of Niagara forms a bar, are fed by the rains and melting snows; and it is stated that their depth is decreasing by the constant felling of timber to supply the numerous steam-

boats, which exposes the snow to melt, and the water to evaporate. In Ireland the great bogs form a kind of natural springs, from which the water gradually oozes to supply the rivers. Other rivers are supplied by mountain caverns with large inlets and small outlets. In countries of continuous rain, the rivers may be continuous without any of these resources.

Leaving the problematical question of navigable canals, we come to the question of irrigable canals. Of *their* value and permanent utility, if India is to make progress, there can be no doubt. Colonel Cotton cannot well overrate them in this particular. My own belief is that in proportion as irrigation extends, population will thicken, and that ultimately it will be found that the whole of the water can be advantageously absorbed to render the dry land fruitful. In hot countries, the roots of the plants appear to be the best absorbents. Rain is not favorable to ripening vegetation. But the process of irrigating land by open channels is a costly one. Along the channels there is a thick and tangled growth of weeds, requiring a constant expenditure of labor to keep down. In the beautiful plain of Valencia, in Spain, the whole water of the river falls short of the necessities of the cultivators, and leaves much good land useless, and generates a perennial strife amongst the peasantry, which rises into an occasional tumult, with loss of life, and has to be put down by the soldiery. There is a proverb about the water:—

"Una mitad al cielo,
Otra mitad al suelo."

"One-half to heaven,
The other half to earth."

Probably, of all the water that springs from the mountain, one-third is absorbed by the sun, and another third by the porous channel, to grow weeds, while only one-third reaches the cultivated land.

In hot Spanish countries, with irrigation, it is customary to plant the acequias or irrigation channels with trees, to prevent evaporation. But there is yet wanting a cheap and efficient mode of conducting irrigation water under ground; and when that takes place, it will be the most valuable gift that modern science can bestow on India, saving human labor, and preventing the waste of water. The water must be filtered before it enters the channels, to prevent deposit; and the channels must be easily accessible, to clear out obstacles. If Colonel Cotton will set himself to work to solve this problem, he will be a still greater benefactor to India than he has yet been.

One chief objection that Colonel Cotton makes to railways is, that by their cost and outlay they will prevent the canalization of the Indian rivers, which would be much cheaper per mile. Yet he says that navigable canals are insufficient, and proposes as an adjunct light railways, the cost of which he does not tell us, though he asserts that the ordinary lines will cost £10,000 per mile. Now, a railway consists essentially of permanent way and rolling stock. These are the two items which cannot be done without, any more than the bridges and levelling. All else, expensive stations, &c., is a question of choice. The permanent way and rolling stock will not exceed £3400 per mile; and earth-works and bridges, at

£1600 more, would only make up £5000 per mile. Horse railways, wholly of iron, to work into this as branches, could be constructed at between £500 and £600 per mile: and by a horse railway, I mean a very permanent horse railway, and not a toy—horse railways that can be laid down by unskilled Indian laborers, after being shown how the first pair of rails go together. I go still further. There are districts where even railways to track light wagons by hand would be desirable, as in Welsh slate-quarries; and they also should be constructed wholly of iron, for reasons obvious enough to those who have had to grub up thorny roots to boil their kettle.

I have for many years past been an advocate, in print and out of print, of light railways for steam power, of horse railways, and of portable railways. In the "*Times*" of January, 1850, and in the "*Spectator*" of February, 1850, these plans will be found favorably reviewed.*

The question of railways might be nearly an exact science, but it is far from that yet. Railways divide into two branches—tram-ways, or trammel-ways, in which the guiding power is on the rail, and railways proper, in which the guide is on the wheel. A commoner division is that of steam locomotion and animal locomotion, the structure varying with the loads to be borne. The railway is better than the trammel-way, for several reasons, as it keeps clearer from dirt and obstacles, and engenders less friction. The mechanical principles which should govern the construction are the same in all cases.

As the object of a railway is to lessen the obstructions to the movement of rolling wheels, we may consider the rail and wheel as man and wife, not to be treated apart; for as a bad wife may make a miserable husband, so a bad wheel may spoil a rail, or *vice versa*.

The first thing to desire in a railway is, that it should be as nearly as possible a horizontal plain, straight, and parallel between the rails.

2d. The rails should be virtually inflexible under the rolling loads. In making a girder bridge over a stream, it is necessary that the depth of the girder should bear such a proportion to the length and load, that it will not deflect in the opening. A rail is, or should be, a girder, likewise non-deflecting; and if the support below it be a yielding material, or solid discontinuous supports, the rail must be deep enough not to bend between the supports or upon the unfirm material, or the result will be a line constantly out of repair, needing what is called maintenance of way

*"A pamphlet just published, entitled the 'Iron Ways,' will be read with satisfaction by proprietors of railway shares, for its hopeful anticipations of what may be effected towards a restoration of profits by the adoption of light and frequent trains. It also contains a number of suggestions on the general development of traffic, which, in point of ingenuity and completeness, as well as in the faith they exhibit in the extent to which the public would avail themselves of increased facilities, resemble the original Post-office plans of Mr. Rowland Hill."—From the "*Times*," Jan. 25th, 1850, Money Article.

"Redemption of the Railway System.—The author shows how the railway world can be rescued from its difficulties, and how the extension of a more manageable railway system, by its minuter ramifications into the very farms, would reconcile farming with free trade, as it would make transit easy both for produce and locomotive farming apparatus, and would thus bring a full manufacturing power and activity into the heart of agriculture. But although the view is put forth by a practical man, its reasoning is so clear, and its method of attaining the proposed end is so direct, that railway folks will pronounce it unpractical."—From the "*Spectator*," Feb. 9th, 1850.

and increasing resistance to traction. The pressure ought to be equally distributed by absence of flexure, and this can only be done by depth.

3d. The rails should be laterally inflexible, or great friction will ensue by the rocking of the engine and carriages. They should be laterally straight, or a continuous sinuous movement will take place.

4th. The junctions of the rails should be so arranged that, while allowing for expansion and contraction, the strength of resistance, both vertically and laterally, should be as great at all the joints as at the intermediate portions.

5th. An efficient connexion should exist between the two opposite rails, to keep them parallel.

6th. The surface of the rails beneath the wheels should be so hard and tough, that they will neither crush nor laminate beneath the rolling loads.

7th. The bearing surface of the rails or supports on the ballast should be of such area that the rolling loads will not disturb it.

8th. The height of the wheel surface above the bearing surface on the ballast should be the minimum, while the bearing surface is the maximum.

9th. The rail should bed into the ground, to keep it steady laterally, and prevent rocking.

10th. The depth of the rail below the bearing surface of the ground should be so much in excess of the rise above the ground as to constitute a suspensive principle, in opposition to the principle of a prop, which is the common mode of structure. Where only light loads are required, the prop plan may be used for convenience; but it is not the form of greatest permanence.

11th. In maintaining the line of way, care must be taken to provide good drainage for wet weather, and easy means of watering in dry weather.

The construction of any railway, great or small, and its mechanical fitness, may be tested by these rules. Various modes of construction may be used, but all should be firm without loose jolting; and though timber sleepers have their advantages, no doubt greater permanence may be attained by an iron structure. Cast iron, if in sufficient masses, will do; but wrought iron is the best: and, to absorb mischievous vibration, loose timber blocks, analogous to wood paving, and not structural, may be applied as a portion of the ballast at a cheap rate.

(To be Continued.)

On Hydraulic Limes, Artificial Stones, and Different Novel Applications of Soluble Alkaline Silicates. By M. Fr. Kuhlman.*

Entrusted, about the close of the year 1840, with some trials relative to some abundant efflorescence, which was formed on a perfectly new building, and which was considered to be due to the formation of nitre, I was soon convinced that the efflorescent salts were formed to a great extent of carbonate of soda, and that the lime which had been used (hydraulic

* From the Lond. Journal of the Society of Arts, July, 1855.

lime, from the neighborhood of Tournay,) was the cause of the efflorescence which had been observed. A closer examination soon taught me that all limes, and particularly hydraulic limes and natural cements, contained appreciable quantities of potash and soda.

Theory of Hydraulic Limes.—In a work which I had the honor of presenting to the Academy, at a meeting held on the 5th of May, 1841, I endeavored to explain the part which potash and soda might play in stones and cements, and I admitted that these alkalies served to bring the silica to the lime, and thus to form silicates, which, by means of the application of water, solidified a portion of the mass, producing the formation of a hydrate, analagous to that which takes place with plaster. I have pointed out since then to the Academy numerous facts as the basis of this theory, and that, among others, of the immediate change from fat lime to hydraulic lime, by simply treating with a solution of silicate of potash. If, after the burning of the limestone, potash is in contact with silica, the silicate which is formed must necessarily re-act, and this can only take place as soon as the burnt lime is brought into contact with water.

I have greatly added to my experiments on this head, and I have established the fact that, with fat lime and silicate of potash, both of them pulverized and mixed in the proportion of 10 to 12 of silicate to 100 of lime, a lime can be obtained which shall have all the characteristics of hydraulic lime. If these substances are not well pulverized the re-action will be very incomplete, and an effect will subsequently be produced, bringing on disintegration. If from my former trials there results the possibility of converting a fat lime into an hydraulic mortar, by sprinkling it with a solution of an alkaline silicate, in my more recent trials I have found a means of producing at once with a vitreous silicate and lime, hydraulic cements of any required degree of strength. This will enable us to form, at a reasonable expense, buildings to stand the action of water, in places where fat limes alone are now found. Powdered silicate of potash in some sort becomes an agent for producing this hydraulic property, of which future experiments will determine the value.

Artificial Stones.—Looking at the great affinity of lime for silica dissolved in potash, I was naturally led to examine the action of alkaline silicates on calcareous stones. Here I was still more fortunate, for the alkaline silicates became at once the means of a variety of applications of the highest utility. Let us look at what is said on this point in the *Comptes Rendus* of the Society's meetings.

"By mixing some powdered chalk in a solution of silicate of potash, a cement is obtained, which hardens slowly in the air, assuming a degree of stiffness, which, under certain circumstances, renders it applicable for the restoration of public monuments and the manufacture of moulded articles.

"Chalk, whether in an artificial paste or in its natural state, plunged into a solution of silicate of potash, takes up, even when cold, a quantity of silica, which may be increased considerably by exposing the chalk alternately to the action of the siliceous solution and the air. The chalk assumes a smooth appearance, a compact grain, and a color more or less yellow, according as it is more or less impregnated with iron.

"Stone thus prepared is susceptible of a high polish. The hardness, which is at first but superficial, penetrates by degrees into the centre, even where there is considerable thickness. It appears capable of becoming of incontestible utility in the formation of works of sculpture and ornaments of the most delicate workmanship; for when the silicifying process—"*silicatization*"—has been effected on well-dried chalk, without which good results are not possible, the surface remains unalterable.

"Some attempts made to render this stone applicable for lithography give promise of great success.

"This method of converting soft limestone into silicious limestone is likely to become a great acquisition in the art of building. Ornaments, unaffected by damp, and of great hardness, may thus be obtained at little cost; and, in many cases, a plaster made with a solution of silicate of potash will preserve from subsequent decay ancient monuments formed of soft limestone. This same plaster may become of general application in those countries where, as in Champagne, chalk forms almost the only building material."

I have shown experimentally that that one part of the silica from the silicate becomes separated by the action of the carbonic acid of the air, but that those parts of the silicate which have come into contact with a sufficient quantity of carbonate of lime pass into the state of silicate of lime. My work, presented to the Academy in 1841, pointed out numerous industrial purposes to which the impregnating of porous bodies of mineral substances might be applied, whether the objects operated upon were organic or inorganic. Considering these applications of the art as of the first importance in building, I have attempted to extend them, and I have just laid before the Academy a new series of observations.

Harmonizing the Shades of the Silicified Stone.—I have given the name of "*silicatization*" to this remarkable conversion of soft and porous limestone into siliceous and compact limestone. As the operation of this process to articles of sculpture and building materials gives rise to a coloring very frequently so marked as to render the joinings more apparent and the veins more distinct, I have been compelled to seek a remedy for this objection.

There are two essential and general points to be met. Chalk walls are too white, while some kinds of ferruginous limestones are too sombre in their shades. To obviate this inconvenience, I perform the *silicatization* of limestones which are too white with a double silicate of potash and magnesia. This is a vitreous substance, which forms a brown solution, and which when used in the process causes a little oxide of manganese to be deposited in the artificial siliceous paste. Oxide of cobalt, too, will combine, though in very small quantities, with silicate of potash. Silica precipitated by a current of carbonic acid is of a brilliant azure blue. This silicate may be used in the treatment of white marbles.

When the shades of the stone are too decided, and that is the most common defect, I obtain good results by mixing in the silicate solution a small quantity of artificial sulphate of barytes, which, in penetrating the porous stone, whilst it forms a layer of silica, remains fixed, entering, as we shall see below, into a state of chemical combination. As regards the joints, they may be made with common cements, the shades of which

may be rendered lighter by means of some white substances, but they may be still more entirely concealed with broken pieces of the stone itself mixed with silicate of potash, the whole being well pulverized previous to its use, and applied in a state of liquid paste.

Coloring the Stone.—In the course of my researches for giving to these silicified stones shades which would cause those portions of our buildings which had been submitted to this process to harmonize with those which had not, I was led to submit the stones to an actual dyeing process by impregnating them in the first instance with certain metallic salts, which, by precipitation, would produce the required color.

Thus, impregnating the stones with salts of lead or copper, and afterwards bringing it into contact with sulphuretted hydrogen gas, or a solution of hydrosulphuret of ammonia, I obtain at will grey, black, or brown shades; with salt of copper and ferrocyanide of potassium I get shades of copper color, &c.

In the present case I have made an observation which in a chemical point of view is not devoid of interest.

I have stated that the porous limestones, when submitted at a boiling heat to solutions of metallic sulphates whose bases are insoluble in water, give rise during the whole reaction, to a disengagement of carbonic acid, and to the fixing in sufficient depths metallic oxides in intimate combination with sulphate of lime. When the metallic sulphates have a colored base, very beautiful tints of different and perfect shades are obtained. Thus, with sulphate of iron we get the production of a tint in red rust, more or less deep according as we operate with solutions of green vitriol more or less concentrated; with sulphate of copper the stone takes a magnificent green tint; with sulphate of manganese brown shades are obtained; with a mixture of sulphate of iron and sulphate of copper we get a chocolate color. I have, also, experimented with sulphates of nickel, chromium, cobalt, &c., and with mixtures of these sulphates.

The affinities which determine the reactions in question are sufficiently powerful to cause the metallic oxides to be completely absorbed by the stone, so much so, that certain oxides, such as that of copper, for instance, entirely disappear from the solutions after boiling with an excess of chalk.

It is remarkable, that when in operating with mixtures of salts of copper and salts of iron or of manganese, the oxides of iron and manganese are the first to be thrown down.

When we operate with sulphates having a colorless base, such as sulphate of zinc, magnesia, or alumina, we equally obtain the precipitation from the oxide, and their penetration to a certain depth in the stone, with a disengagement of carbonic acid.

The bi-sulphate of lime gives analagous results.

In general, when we intend to use colored stones in buildings, &c., or to form mosaics, it will be found useful to increase their hardness by the silicifying process.

We may proceed in the same way with articles in shell, white coral, &c., in which the color may be produced by the same process, acting at different pressures.

I will conclude this head with an important observation, which is, that

the double sulphates which are formed in penetrating the stone, make a body with it, and increase its hardness to such an extent, that when certain sulphates are employed, such as that of zinc, the silicifying process becomes unnecessary.

The editor of "*Cosmos*" adds, the process which has just been described, is likely to tend to the production of a great and new industry, splendid specimens of which are to be found in the Exposition Universelle, placed in the central gallery of the "*Annexe*," on the banks of the river, opposite the produce from the mines of Anzin. We shall examine these specimens with care, and give a detailed account of them when we treat of the section of the chemical arts. The display made by the celebrated chemist of Lille is one which deserves great attention.

Cosmos.

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*A Railway Speculation.**

The East Lancashire Railway Company have adopted means similar to those some years since started by some of the metropolitan companies, to induce building operations in the vicinity of their line. To any person who will build houses within two miles of their stations at Maghull, Ormskirk, Burscough, or Town Green, of the clear annual value of 50*l.* per annum, they guarantee the privilege of nominating one resident, who shall travel free, as a first-class passenger, between these places and the Liverpool Exchange station, during a term varying from seven to eighteen years, according to the position of the houses erected.

Railway Traveling.†

The "*Liverpool Chronicle*" reports that "the Judge of the County court, Liverpool, lately decided in "Nash *v.* the London and North Western," that passengers whose luggage had been missent by railway officials are not in his court entitled to recover any expenses or loss of time in seeking after or waiting for such luggage, and that passengers should understand that they are entitled to sue for the full value of such luggage immediately on the loss or missending happening, without waiting for or incurring any expense in seeking after the luggage, however beneficial to the Company any efforts may be for the purpose."

AMERICAN PATENTS.

List of American Patents which issued from August 7, to August 28, 1855, (inclusive,) with Exemplifications.

AUGUST 7.

1. For a *Machine for Printing Textile Fabrics;* James Melville, Roebank Works, Great Britain, and Joseph Burch, Craig Hall, Great Britain.

Claim.—"1st, The mode of printing in two or more colors by means of a movable color apparatus, in connexion with the pattern printing roller traversing laterally on a

*From the London Builder, No. 645. †From Herapath's Journal, No. 826.

slide rest, by means of which, the colors in a repeat are printed without shifting the printing roller. 2d, The application of a slide rest guiding apparatus for guiding and regulating the action of the pattern printing roller, when the mode of connecting such slide rest apparatus with the impression cylinder is by means of a grooved shaft traverse movement. 3d, The mode of adjusting the position of the printing roller at the repeat shifts by means of notched or serrated plates set to correspond to the different repeats. 4th, The mode of printing carpeting and other fabrics by means of printing rollers corresponding to the several colors in the repeat, set one in advance of the other in the direction of the main cylinder's revolution, that revolution being continued until the colors are duly impressed upon or into the surface."

2. For an *Improvement in Gas Regulators;* Samuel W. Brown, Lowell, Mass.

Claim.—"Constructing a quicksilver cup, or its mechanical equivalent, within the inside of the float through which the gas passes on its way to the burners, in combination with the induction tube, or its mechanical equivalent, for the purposes of constituting a self-acting valve or valve seat to evenly regulate the flow of the gas."

3. For an *Improvement in Railroad Signals;* Jacob Busser, Philadelphia, Pa.

Claim.—"The combination of the cams, spring, C, and the rods, operating upon the bell, or its equivalent, and spring P, which are placed upon the draw of the bridge, so that a locomotive, in approaching the draw, will sound the alarm, whilst a locomotive coming from the draw, will pass over the same cams without sounding the alarm."

4. For an *Improvement in Iron Houses;* D. D. Badger, City of New York.

Claim.—"The method of securing the bases of the columns to the breast summers or lintels by bolting each on the inner side to a broad flanch and keying it on the outerside by a key, whereby they are properly secured against any movement back or forth on the breast summers or lintels, or against falling outwards, but are not prevented from falling inwards when they become insecure."

5. For an *Improvement in Machines for Preparing Flocks;* Leander W. Boynton, Worcester, Massachusetts.

Claim.—"The combination of the screw with the brush or brushes, when the brush or brushes have both a rotary and reciprocating motion."

6. For a *Plane Scraper;* Leonard Bailey, Winchester, Massachusetts.

Claim.—"Combining the scraper or plane cutter with the stock by means of the movable holder and its adjustable mechanism."

7. For an *Improvement in Looms;* John Broadbent, Oak Grove, Kentucky.

Claim.—"1st, The insertion of the filling thread by means of two hooks or sets of hooks, arranged to operate one on each side of the cloth, one to carry the filling thread to the middle of the shed, where it is met by the other, which takes the thread from the first and returns with it, thus drawing the thread entirely through the warp. 2d, The employment of the said two hooks or sets of hooks, each as a deliverer, to give the thread to the other, and receiver to receive the thread from the other alternately, by which means a good and fast selvedge is made on both lists of the cloth. 3d, The employment of two tending forks made of any form and arranged and operated in any manner, to conduct the filling threads into proper positions to be caught by the delivering filling hooks. 4th, Giving the two filling hooks or sets of filling hooks, each in turn, a sufficient movement laterally to the path in which they move to insert the filling, for the purpose of enabling one to pass the other in the shed to take from it the filling thread. 5th, Giving the receiving hook a sufficient movement towards the middle of the cloth after it has drawn the filling through, and before the falling back of the ley, to disengage it from the thread of filling which it has just drawn through."

8. For an *Improvement in Machine Drills;* James Conner and Thomas Newby, Richmond, Indiana.

Claim.—"The use of the lever, vertical shaft, spring and trigger R and S, spring Z and cam, by which the action of the drill in drilling is regulated or grooved in its depth."

9. For an *Improved Method of Hanging Mill Stones;* Robert Cochrane, Cincinnati, Ohio.

"The nature of the invention consists in the arrangement by which I enable a grist

mill to true itself, if, on being put in motion it is not true, and to keep itself true so long as it is in motion. There is no wabbling nor shifting, once the true centre is self-obtained, the parts keeping their true position as fixedly as if the whole was one solid mass."

Claim.—"The movable cock-eye placed in the recess on the top of the spindle, to co-operate with the cock-head fit in the balance-rine, or their mechanical equivalents."

10. For an *Improvement in Straw Cutters;* Dewitt C. Cumings, Fulton, New York.

Claim.—"1st, The upward cut, when the material is fed in by a distinct device for that purpose, by which the dirt is separated from the straw or other material to be cut, passing out beneath the feed rollers instead of collecting on the stationary guard or cutting plate. 2d, Operating the movable feed roller by means of a spur wheel hung in a vibrating frame or yoke, with a universal coupling for connecting its axis with that of the roller, when said roller is independent of spring bearings independent of each other."

11. For an *Improved Cutter-Head for Irregular Forms;* Daniel Dunlap, Concord, New Hampshire.

Claim.—"Combining with or arranging in connexion with the rotary guide and each of its knives, the cylinder crescent gauge, whereby, while the pattern or "former" is borne against the guide head, the material will not only be reduced by successive cuts until brought down to its proper depth, but the danger of accident diminished. Also, the improved mode of applying and securing each of the cutters to its stock or supports, whereby, by a force acting longitudinally of them, they are not only held in such direction, but, at the same time, are pressed laterally against the curved inner faces of the gauges."

12. For an *Improvement in Corn Planters;* Robert W. Fenwick, Brooklyn, New York, and Reinhold Boeklen, Jersey City, New Jersey.

"The nature of the invention consists in a novel combination and arrangement for operation together by alternate thrust and pull imparted to the exterior or planting tube of a valve at the lower end of the said tube, with a seed slide, which forms part of a circle and is arranged to turn on a centre."

Claim.—"The combination and arrangement of the swinging seed slide, valve, and tube."

13. For an *Improved Wrench;* Alden Graham, Roxbury, Massachusetts.

Claim.—"Fitting the jaws, when turning on pivots, in the slot, and operating the same by a ring having a screw thread on its inner surface, to work between threads cut on the outer surface of the jaws."

14. For an *Improvement in Apparatus for Discharging Atmospheric Electricity from Telegraph Wires;* John N. Gamewell, Camden, South Carolina. Patented in England, September 15, 1855.

"The nature of the invention consists in an instrument which is intended to connect the main wire of the telegraph with the receiving magnet at every station, for the purpose of transmitting only the galvanic or writing current, and discharging into the earth before it can arrive at the magnet, all atmospheric electricity, with which the wires become surcharged, when the atmosphere is in a highly electrical state."

Claim.—"The method of obstructing the passage of atmospheric electricity along the line from one discharging point to another, or their equivalents, provided for a similar purpose, by reducing the capacity of the conductor forming said line, and immediately after its junction with the discharging points, whether that reduction consists in the employment of an inferior conducting material, or in reducing the dimensions of the conductor, or any other equivalent method of reducing the conducting capacity of those parts of the line, thereby forcing the discharge of the atmospheric electricity from the points."

15. For a *Gauge Attachment for Hand Saws;* A. F. Gray and J. C. Fincher, Thibodeaux, Louisiana.

Claim.—"Attaching to one side of the blade of a hand saw, a gauge formed of two strips and lugs, having slots made in them, through which slots, set screws pass, the screws also passing through the saw blade."

16. For an *Improvement in Braiding Machines;* Liveras Hull, Charlestown, Mass.

"The object of my machine is to braid the external covering of a whip stock or handle, said machine being equally adapted to braiding cords or for covering threads of caoutchouc."

Claim.—"The arrangement of the bobbin, the pawl, and the weight within the racer, or with respect to one another therein."

17. For an *Improved Mode of Securing Tires upon Wheels;* John L. Irwin, Franklin, Alabama.

Claim.—"Attaching or adjusting tires to wheels by having the ends of the tires bent, so as to form lips or projections, through which a screw bolt is passed for the purpose of drawing the ends of the tires together and fitting the same tightly to the felloes or rim, the rim having a recess made in it to receive the lips or projections and screw bolt, the recess being covered by a cap."

18. For an *Improvement in Ships' Winches;* Peter H. Jackson, City of New York.

Claim.—"The reversible or double acting pawl, 4, below the ratchet wheel, in combination with the double acting pawl, *d*, to which power is applied to rotate said ratchet wheel in either direction."

19. For an *Improvement in Propelling Vessels by the Direct Action of Steam on the Water;* William J. McIntire, City of New York.

Claim.—"Protecting the steam from condensation by discharging at the same time with it, some non-condensible gas or gases or fluids, or both in combination, in such a manner as to form an envelope for the steam."

20. For an *Improvement in Manufacturing Carpets;* John G. McNair, West Farms, New York.

"The object of my invention is to produce a fabric having a figure on the two surfaces, like what is known as the ingrain carpets, with the colors of the figure reversed, but without a figuring warp."

Claim.—"The fabric described produced by the double wefts, one or both of which is parti-colored, in combination with the two sets of warps, one to divide and ingrain the wefts, and the other to bind in the wefts."

21. For an *Improvement in Dental Chairs;* D. W. Perkins, Rome, New York.

Claim.—"1st, Tightening the ball and socket joint, so as to secure the body of the chair in the desired position, by means of the band which encompasses the socket, the band being operated upon by a clamp, whereby the parts, *e f g*, of the socket may be pressed or bound snugly around the ball. 2d, Attaching the head rest to the inner edge of the plate o by hinges, and having the head rest secured at the desired angle of inclination by a segment rack, P, the plate o being allowed to slide laterally upon a plate Q at the upper part of the bar, which bar works in an opening in the back of the chair, and is secured at the desired point by the rack v and spring catch, for the purpose of rendering the head rest capable of perfect adjustment."

22. For an *Improved Machine for Measuring and Weighing Grain;* Charles A. Postley, Philadelphia, Pennsylvania.

"The nature of the invention consists in a new and improved combination of parts, for the purpose of measuring and weighing all kinds of grain, and giving the weight of every bushel as measured at the time of removing."

Claim.—"The combination of the weighing mechanism, or its equivalent, with the series of measures upon an endless chain, which carries them in succession under the hopper, under the strike, and over the scales. Also, the combination with the lever, M^2, and valve respectively of the lever M, operated by the cam, or its equivalent, and of the platform and levers *g* and g^2, by which the said valve may be operated by the motive power of the machine, or failing this at any time, by the weight of the grain itself."

23. For an *Improved Mode of Adjusting Blinds to Windows, &c.;* Charles E. Parker, Boston, and Joseph Sanger, Watertown, Massachusetts.

Claim.—"Attaching the ropes or chains to the two parts of the blind, *c c*, so that a portion of the ropes or chains will pass on the outer side of the casing and within the apartment or house, and thereby allow the parts of the blind, *c c*, to be adjusted as desired without raising or opening the sashes."

24. For a *Machine for Sawing Lumber;* R. E. Parkhurst, Brunswick, Maine.

Claim.—"1st, The method of connecting the rack bar to the carriage, so that the bar may have a slight motion independent of the carriage. 2d, The dogs, in combination with the notched bar, whereby they may be instantly moved and set to accommodate them to different lengths of log. 3d, The method of connecting the dogs with their sliding guides, whereby they may be operated longitudinally and transversely. 4th, The pointed screw dogs. 5th, The saw guide, so constructed as to be thrown out of the way by the log. 6th, The double dog, which, when out of use, may be sunk flush with the surface of the head block, and may be run in and out for the purpose of sawing the but and point of shingles."

25. For an *Improvement in Seed Planters;* Silas G. Randall and James H. Jones, Rockton, Illinois.

Claim.—"The use of a sheath and a tongue filling it, so combined with a lever and forcing handle, that by means thereof, or their equivalents, the sheath and tongue may be struck into the ground as one solid piece, after which the tongue may be raised, leaving the sheath in the earth as a lining until the seed is deposited through the lining."

26. For an *Improvement in Molasses Pitchers;* Edward Page, Worcester, Mass.

Claim.—"The application to molasses cups of a vessel to catch the molasses which drips from the cup, and the vessel to swing."

27. For an *Improvement in Forming Screw Threads, &c., in the Necks of Glass Bottles and similar articles;* Amasa Stone, Philadelphia, Pennsylvania.

Claim.—"The construction of tools for forming screw threads angular or other scores in the necks and orifices of glass, earthen, or other bottles, and other articles, by making the plug which forms the interior of the orifice to turn with the bottle, jug, or other article, while the material of the orifice is worked around it."

28. For an *Improvement in Tanning Apparatus;* George W. Smith, Nanticoke, N. Y.

Claim.—"Surrounding the ordinary tan leaches with a water chamber, not limited to a particular form or mode of structure, but comprising any form by which the leaches are surrounded by water spaces. (The object being to preserve the leaches from decay.)"

29. For an *Improvement in the Construction of Artificial Legs;* Addison Spaulding, Lowell, Massachusetts.

Claim.—"1st, The knee spring, or its mechanical equivalent, for throwing forwards the portion of the leg marked A, at each step of the artificial leg. 2d, The ankle spring, or its mechanical equivalent, for swinging up the forward portion of the foot on the axis or pin or other turning point at each step of the operator. 3d, The chain or rod connected and combined with the india rubber, or their mechanical equivalent, which is secured in the heel of the foot to allow the leg A a slight elasticity when placed upon the ground, and tipped forward by the operator, to prevent the shock upon the cords and nerves in the stump of the natural leg."

30. For an *Improved Self-Adjusting Tongue Iron;* William J. Temple, Princeton, Massachusetts.

Claim.—"Making the part B (the iron) movable and self-adjusting, in connexion with the lever, or any similar means to raise it."

31. For an *Improvement in Oil Drippers;* James M. Thompson, Holyoke, Mass.

Claim.—"The arrangement of the chamber, in combination with the tubes."

32. For an *Improvement in the Bed Spring of Leather Splitting Machines;* John B. Tay, North Woburn, Massachusetts.

Claim.—"A bed or back spring, as composed of a thin guard or spring sheet of metal and a series of separate springs united to or forming part of a plate."

33. For a *Spoke Machine;* William Van Anden, Poughkeepsie, New York.

Claim.—"1st, The use of the upper and lower adjustable cutter holders made adjustable laterally on their axis, in combination with the curved stationary cutters and adjustable cutters and collars for adjusting the same, or their equivalents. 2d, The use of the adjusting yoke and the attachments thereto for adjusting the cutter holders, or

their equivalents, in combination with the cutter holders on the spoke rest carriage, or their equivalents. 3d, The use of the double acting adjusting levers, or their equivalents, in combination with the cutter holders and their axles, and their combination with the pawls attached to the double acting adjusting levers and cams for operating the same, or their equivalents."

34. For an *Improved Machine for Attaching Hooks and Eyes to Cards;* Addison Capron, Attleborough, and Joseph S. Dennis, Somerville, Massachusetts, Assignor to selves and Henry M. Richards, Attleborough, Massachusetts.

Claim.—"The combination, or substantially the same, of a feeding receiver made to receive the articles and maintain them at proper distances asunder, a cord or sheet feeding mechanism, and sewing machinery on one or both sides of said receiver."

35. For an *Improvement in the Manufacture of Daguerreotype Cases;* Halvor Halvorson, Cambridge, Massachusetts, Assignor to Horace Barnes, Boston, Mass.

Claim.—"The improvement in the manufacture of picture cases or other articles of like character from a composition of shellac and fibrous material, the same consisting in making said case or article of the said composition and one or more sheets of paper, and pressing and combining the whole together in a press or between dies, so that the paper shall combine or connect itself directly with the composition without the aid of cement interposed between them, and serve to add great strength to the article so made. Also, the improvement of ornamenting the surfaces of the impression of the die with burnished gold, the same consisting in applying the gold to the surfaces of the sheet of paper, or its equivalent, burnishing it while on said surface, and laying the said burnished surface in contact with the surface of the die, and pressing said paper and the plastic composition together and into the die, so as to force the burnished gilding paper and composition upon it. Also, the extension of the paper up the inner surfaces of the sides of the case, and by means of pressure in the moulds, the same being for the purpose of enabling to affix to the side the velvet covered frame for the support of the picture, the mat, and the glass thereof."

36. For an *Improvement in the Manufacture of Plate Glass;* Phillippe Stenger, Assignor to Pascal Yearsley, Philadelphia, Pennsylvania.

Claim.—"The application of tractile force to the manufacture of plate glass by means of the mechanical arrangement described, or its substantial equivalent."

37. For an *Improvement in Machinery for Making Paper Pulp;* Lewis Koch, Assignor to Peter B. Sweeney and Michael Lacour, City of New York.

Claim.—"The combination of a series of rollers, increasing gradually in diameter and speed in proportion as the wood or fibrous vegetable substance is extended or pressed out. The face or circumference of one of every pair of extending rollers having a greater speed than the face of its corresponding roller, producing thereby a slight dividing or separating motion in connexion with the pressure upon the substance, which separates each fibre without destroying the same, for the purpose of making pulp from wood and fibrous vegetable substances."

38. For an *Improvement in Temples for Looms;* James Smith, Laurel, Maryland, Assignor to self and William Bothwill, Howard County, Maryland.

Claim.—"The temple roller formed with solid raised conical shaped pin teeth, having a hinged cap to its case, all attached to a flexible rod, in combination with the forked spring when adjustable in brackets."

AUGUST 14.

39. For an *Improved Egg-Holder;* Francis Arnold, Haddam, Connecticut.

Claim.—"Securing or holding eggs within boxes, or on table casters, and other articles, by means of the elastic clamps, constructed as described, or in any equivalent manner."

40. For an *Improvement in Governors for Steam Engines, &c.;* John Arthur and Evan Arthur, New Brunswick, New Jersey.

Claim.—"A governor composed of one or more arcs, rings, or bands of elastic material, applied to a revolving spindle, with a rigid attachment to the said spindle at one point and a loose or sliding attachment at another point, the sliding part or parts being connected with the throttle valve."

41. For an *Improvement in Making Zinc White;* John E. Burrows, Newark, N. J.

Claim.—"The manufacture of white oxide of zinc from ores of zinc or franklinite, by means of a furnace, having perforated grate bars, and an air chamber underneath them, in which hot or cold blasts of air are forced to unite with the ignited mass of fuel in a different state, by passing through the perforations of the grate bars to liberate the zinc in the form of vapor, in manner of construction and mode of operation as set forth."

42. For an *Improvement in Apparatus for Replacing Cars;* Fortune L. Bailey, Freeport, Indiana.

Claim.—"The arrangement of eccentric wheels on either side of the rails, the outer ones being slightly smaller than the inner ones, so counterpoised, that the smaller portion of said eccentrics shall remain downward when not in use, for the purpose of lifting and directing the cars on to the track, when they have been thrown off, by rolling upon said eccentric wheels."

43. For an *Improvement in Whiffle Trees;* Oramel C. Barnes and O. J. Barnes, Stockbridge, Vermont.

Claim.—"The application of the angle shaped iron, forming the solid iron groove, together with the wedge and bearing for the hook."

44. For an *Improvement in Corn Planters;* Andrew J. Barnhart, Schoolcraft, Mich.

Claim.—"Operating the box and plunger, by means of the rods attached to an oscillating arm, which is placed on the shaft of the distributing roller, whereby the box and plunger are made to move simultaneously in opposite directions."

45. For an *Improvement in Compositions for Treating Rubber and Gutta Percha;* Francis Baschnagel, City of New York.

Claim.—"The conversion or restoration of caoutchouc or gutta percha, whether they have been vulcanized or not, into a soft, plastic, and workable state, (by a combination of chemical agents,) so that they may be re-manufactured in a state already vulcanized or not, according as the substance converted or restored had or had not been vulcanized. The substances which I use for this purpose, being bi-sulphuret of carbon in conjunction with alcohol absolute, and not common alcohol, without the addition of any other chemical agent and without the application of heat. To 100 pounds of caoutchouc or gutta percha cut in pieces, add ¼ pound of alcohol absolute and ten pounds of carbon bisulphuratum, the whole to be placed in a vessel hermetically sealed, and allowed to remain closed for two hours."

46. For an *Improvement in Churns;* Jacob Boyers, Granville, Virginia.

"The nature of the invention consists in giving such a direction to the cream placed in the tub of the churn, by the action of the agitator, that it shall assume the character of a screw, whereby the butter, by an action resembling that of wringing clothes, is separated from the butter-milk in a more solid condition and gathered in a mass at one side of the churn."

Claim.—"The shaft, in combination with the dashers, when arranged and combined in the manner as set forth."

47. For a *Mode of Straining Saws by Atmospheric Pressure;* A. Brown and Abel Coffin, Jr., Sabine City, Texas.

Claim.—"Providing the closed ends or heads of the cylinders with "shifting" valves, opening outwardly and freely hung or operating when the said cylinders with their pistons are arranged in relation to the saw, and the pistons and valves operate together, whereby, the reciprocating action of the saw is made to clear the cylinders without the aid of a separate exhaust pump."

48. For an *Improved Hand Press for Printing;* Dexter H. Chamberlain, West Roxbury, Massachusetts.

Claim.—"1st, The "percussion hand press," consisting essentially of the block or type carrier sliding upon the lever, the ink roller, and bed. 2d, The method of adjusting the head to the surface of the types, whatever may be the thickness of the plate which carries them."

49. For a *Ventilating Faucet;* Charles Cleveland, Ashfield, Massachusetts.

Claim.—"The combination of a ventiduct with a faucet."

50. For an *Improvement in Steam Boilers;* J. J. Dutcher, New Haven, Connecticut.

Claim.—"1st, Placing within the cylindrical water body of a boiler, one or more cylindrical flues, terminating at their ends in frustums of cones, which frustums all have the truncated ends towards the fire box and the bases towards the chimney, and serve to form communication through the cylinders from the fire box and towards the chimney. 2d, The arrangement of the two cylinders, cones, pipes, and passages."

51. For an *Improvement in Cotton Presses;* H. H. Fultz, Lexington, Miss.

Claim.—"The arrangement with the retaining and driving pawls on either side of the follower rod or rock bar of the one spring, bearing at its opposite ends on the said pawls and hung upon an intermediate pivot in relation thereto, so that, upon turning the spring, both the retaining and driving pawls are expeditiously and simultaneously relieved from or thrown into spring gear with the follower rod, and the working of the follower in its reverse directions is expedited."

52. For an *Improvement in Alloys for Journal Boxes;* Joseph Garratt, Sen., Indianapolis, Indiana.

Claim.—"The production of an alloy of a bluish gray color, which, while it has unsurpassable anti-friction qualities, has also sufficient tenacity to allow of journal boxes being formed of it that do not require the protection of outer casings of a harder metal, the said alloy being composed of zinc, copper, and antimony in about the following proportions, viz: seventeen parts zinc, one part copper, and one part and a half of antimony, or any other mixture substantially the same and which will produce the same effect."

53. For an *Improved Extension Vehicle;* Benjamin W. Gay, New London, N. H.

"The nature of the invention consists in so constructing vehicles, whether on runners or wheels, as to be capable of being extended to a double seated, or contracted into a single seated conveyance, by means of a double or single screw perch connecting the fore and hind bed pieces together."

Claim.—"1st, The screw perch. 2d, The application in combination with said screw perch of the rods."

54. For an *Improvement in Windlasses;* W. N. Gesner, Fair Haven, Connecticut.

Claim.—"The employment or use of the guide pulley attached to the frame, the frame being connected to the framing or block."

55. For an *Improvement in Hernial Trusses;* E. B. Graham, Middletown, N. Y.

Claim.—"The means of adjusting and securing the pad in any desirable position, consisting of the square toothed rack, the adjustable square toothed and slotted spring catch, and the screw, all combined and applied as set forth."

56. For an *Improvement in Making Zinc White;* Samuel T. Jones, City of N. Y.

Claim—"The manufacture of white oxide of zinc from ores of zinc or franklinite, by means of a furnace having perforated grate bars and an air chamber underneath them, in which hot or cold blasts of air are forced to unite with the ignited mass of fuel in a diffused state, by passing through the perforations of the grate bars to liberate the zinc in the form of vapor, in manner of construction and mode of operation as set forth."

57. For *Furnaces for Heating Buildings;* Joseph Leeds, Philadelphia, Pa.

Claim.—"Combining with the cylinder or fire pot of an air heating furnace, a reservoir or fountain of water, which furnishes a wet surface, against which the incoming air strikes for moistening it and depositing its dust, and a series of curved zigzag fluted or corrugated plates for enlarging the heating surface of the furnace, and forming airducts for the heated air to pass through."

58. For an *Improvement in the Cutting Apparatus of Harvesters;* Robert J. Morrison, Richmond, Virginia.

Claim.—"The hinging of the lids and allowing them to rest severally and independently upon the moving cutters."

59. For an *Improved Forging Machine;* Daniel Nayes, Abington, Massachusetts.

Claim.—"1st, Attaching the hammer or hammers of a forging machine beach by a

pivot to a revolving disk or crank, so as to revolve therewith, and controlling the position thereof by stops attached to the face of the disk or crank, whereby, after the hammer has been caused to strike on the anvil by the revolution of the disk or crank, it will be, by the continuous revolution thereof, drawn lengthwise of the anvil to enable its revolution to continue for another blow. 2d, The employment of an anvil with a face forming the interior of a right angle, in combination with two hammers operating at right angles to each other against the said faces. 3d, The arrangement of the movable carriage or rest relatively to the two faced anvil and the hammers."

60. For an *Improved Mode of Hanging Window Sashes;* L. E. Payne, Yazoo City, Mississippi.

Claim.—"Applying the cords to the sashes, viz: the cords passing around the lower sash, so that said cords may work around the lower sash, or said sash may be raised or lowered without moving the cords."

61. For an *Improvement in Machines for Gathering Cotton Stalks;* Richard Ray Louisport, Kentucky.

Claim.—"The arrangement of the apron, plate, and rake, for the purposes of pulling up and gathering stalks of cotton."

62. For an *Improvement in Gas Regulators;* Stephen P. Ruggles, Boston, Mass.

Claim.—"In combination with a gas burner, a floating tube, which stands across and controls the flow of gas through the gas way."

63. For an *Improvement in Harvesters;* Fisk Russell, Boston, Massachusetts.

Claim.—"So arranging the rocker frame, that it may rotate in the end of the lever while said rocker frame is operated upon by the serpentine cam wheel which it embraces."

64. For an *Improvement in Furnaces for Heating Buildings;* Samuel B. Sexton, Baltimore, Maryland.

"The nature of the invention consists in covering the fire chamber with a pair of concave convex plates, placed one above the other, with their convex surfaces outward, and slightly separated along their edges. The space between the concave surfaces of the plates communicating by a pipe with the external air, so that a current will pass through this space, and issue from the opening between the edges of the plates into the main air chamber and pass from thence by the usual exit flues."

Claim.—"The convertible covers of the fire chamber, in combination with the pipe."

65. For an *Improvement in Railroad Car Brakes;* Gustavus Adolphus Somerby and Charles William Fogg, Waltham, Massachusetts.

Claim.—"Applying the wheel axle to the frame by means of pendulous bars, in order that the gravity or weight of the carriage, when the latter is at rest, (as well as when it is in motion,) may be employed to press the wheels against the brakes by acting through such bars, when they are inclined from the vertical and are left to be free to be moved towards the brakes. Also, so combining with either or both the lower brakes, one or more other brakes, or brake mechanisms, that the latter may be put in action by the operations of the wheels on the former. Also, in combination with wheels, applied so as to be movable towards and away from their brakes, a mechanism, whereby the power that produces draft of the carriage or puts it in motion, shall move such wheels away from their brakes, so as to relieve the said brakes from being moved or pressed by their respective wheels."

66. For an *Improvement in Cotton Gins;* John Simpson, Lewisville, S. C.

Claim.—"Making the alternate saws of a greater diameter than the intermediate saws, in order that no two adjacent ones may seize the same fibres, and thereby break them, but, at the same time, to gin as completely and rapidly as if the saws were all of the same diameter. Also, arranging the brushes, which sweep the smaller saws, upon alternate wings projecting out from the centre as much further than the intermediate wings, which bear the brushes for sweeping the larger saws, as said saws project beyond the other, for the purpose of rendering the brushes all of a uniform and suitable length. Also, arranging the mote board, so as to slide backward or forward, for regulating the strength and direction of the blast and properly separating the motes from the cotton, and also to be used as a lid to entirely close said space when the gin is not in use."

67. For an *Improvement in Gun Locks;* Michael Trowley, Mount Vernon, Illinois.

Claim.—"Constructing the lock by having the lower part of the hammer formed of two prongs, *d e*, against one of which the spring *c*, bears, and having the upper end of the tumbler attached to the other prong *e*. The lower end of said tumbler being attached to the upper end of the trigger. The front end of the spring *c* having a small spring *l* attached to it, which spring *c* bears against the trigger."

68. For an *Improvement in Tanning Compounds;* Otis B. Whattles, Waddington, New York.

Claim.—"1st, The employment or use of soap, combined with salt and lime for unhairing or depilating the hides. 2d, The employment or use of soap, combined with the tan liquor for tanning the hides."

69. For a *Portable Steam Sawing Machine;* Samuel R. Wilmot, City of New York.

Claim.—"1st, The attachment of the opposite end of the steam cylinder to that at which the saw works, by a pivot to the main frame or bed piece of the engine, so that the cylinder may swing to and from the said frame or bed piece for the purpose of allowing the saw a proper range and feeding it. 2d, Furnishing the main frame or bed piece of the engine with dogs to drive into the tree or log on opposite sides of the saw, whereby greater stability is given to the engine and saw when in operation without making the engine or its frame of great weight."

70. For an *Improved Device for Opening and Closing Gates;* Caleb Winegar, Union Spring, New York.

Claim.—"The fan wheel and shaft, the cog wheel, the ratchet wheel, and spring catch, as applied to said invention, not limited to the precise arrangements, but to vary the same at pleasure while obtaining the same ends by means substantially the same."

71. For a *Method of Drawing Water from Wells;* Caleb Winegar, Union Springs, New York.

Claim.—"The guiding of the bucket by means of two wires, or their equivalents, suspending two weights near the bottom of the well in combination with the gate frame."

72. For an *Improvement in Coffee Roasters;* Samuel Pierce, Assignor to Curtis B. Pierce, Troy, New York.

Claim.—"Constructing the roasting vessel of a series of alternate longitudinal angular parts projecting inward and co-extensive concave portions swelling outward."

73. For an *Improvement in Mills for Compressing and Grinding Grapes and other Small Fruits;* Z. Coleman Robbins, Washington, D. C., Assignor to Anson Martin, Norwich, Connecticut.

Claim.—"The combination and joint action of the compresser and the cylinders for compressing and grinding grapes."

74. For an *Improvement in Apparatus for Sifting;* Edward Louis Seymour, Assignor to W. O. Bourne, City of New York.

Claim.—"The several cylindrical sieves, one within the other, provided with conduits, so arranged as to deliver the proceeds continuously."

AUGUST 21.

75. For an *Improvement in Candlesticks;* C. W. Blakeslee, Northfield, Connecticut.

"The nature of my invention consists in extending the upper ends of the wires which form the body of the candlestick, through a dish shaped plate, so as to form a spring socket for the reception of the candle."

Claim.—"I do not claim forming the body and base of the candlestick of wire, neither do I claim a spring clamp or socket in itself considered or independently of the mode of constructing or forming the same, as herein shown, for they have been previously used; but I do claim extending the wires of the body of the candlestick through a dish shaped plate substantially as shown, for the purpose of forming a spring socket for the reception of the candle."

76. For an *Improvement in the Application of the Conical Pendulum to Time Keepers;* John C. Briggs, Concord, New Hampshire.

"The nature of my invention consists in causing the pendulums of clocks to oscillate in circles or ellipses, the motion being kept up by spindles coming up from below, within the circumferences described by the pendulum balls."

Claim.—"The application to clocks, time pieces, or other machinery, as a regulator of a rotary or conical pendulum, the rod of which is flexible and attached at its upper end to a fixed point above and without the described cone, and extending only below the point of support; the pendulum to be kept in motion by a spindle coming up from below."

77. For an *Improvement in Sealing Cans;* William Burnet, Cincinnati, Ohio.

Claim.—"The use of a clamp cap constructed substantially as described, for the purpose of closing the opening in the can between the filling and the final sealing thereof."

78. For an *Improvement in Obstetrical Extractor;* Almond C. Buffom, Chicago, Ill.

Claim.—"An obstetrical extractor, which, from the peculiar form of its fingers and by means of three cross bands interlaced by down straps, so clasps and supports the head of the child, as that the force necessary to assist its delivery can be applied without injury to mother or child. Also, that by means of the frustra the instrument can be ready for application, so small and of such shape, that it can be applied more readily and with less risk and pain to the patient than any forceps or other extractor in use."

79. For an *Improvement in Glass Journal Boxes;* Edward Campbell, Columbus, O.

Claim.—"I do not claim the union of glass and iron, whilst the former is in a plastic state and the latter at a red heat, by pressure to produce a welding of the two; but what I do claim is, a journal box composed of an iron body and an anti-friction lining surface of glass, when the said glass lining is combined with its iron back, as set forth."

80. For a *Swimming Glove;* Dugald Campbell, City of New York.

Claim.—"The use or employment of flexible webs uniting the thumbs and fingers of gloves."

81. For an *Improved Wrench;* John D. Dale, Philadelphia, Pennsylvania.

Claim.—"1st, The combination of the reversible flanched and winged hub and pawls with the upper and lower ratchet wheels, constructed and operated as described. 2d, The combination of the angular jaws and worm plate, or their equivalents, with the upper and lower ratchet wheels, and the mechanism giving them a continuous motion either to the right or left."

82. For an *Improved Basin Stop-Cock;* Henry Eling, City of New York.

Claim.—"I do not claim closing a cock by means of a spring when said cock is not provided with a screw valve; but I do claim making the cap independent of the nut, so that by simply loosening the nut, the cap may be turned and the valve adjusted."

83. For an *Improved Pressure Water-Wheel;* William Fields and Solomon Gerhard, Wilmington, Delaware.

"The nature of my invention consists in combining with a water-wheel, running in a case or chute, a balance valve hinged in the centre."

Claim.—"The combination of the valve with the buckets upon the wheel revolving in the case."

84. For an *Improvement in Pumps;* Sylvester H. Gray, Bridgeport, Connecticut.

Claim.—"I do not claim operating the two pistons of a single cylinder double acting pump by means of two racks and a pinion, when said racks and pinion are arranged above the top or below the bottom piston, and the rod of one piston passed through the rod of the other; but I do claim the employment and arrangement of the rod and pinion combined between the pistons."

85. For an *Improvement in Hemp Cutters;* J. Lock Hardeman, Arrow Rock, Mo.

Claim.—"1st, The side reel constructed and applied for hemp, grain, or other arti-

cles of like nature, such reel having curved arms, be the curvature more or less. 2d, The cleaning shears."

86. For an *Improvement in Bridges;* Horace L. Hervey, Quincy, Illinois, and Robert E. Osborn, Springfield, Ohio.

Claim.—"The arrangement of the blocks and posts, in combination with the adjustable suspension truss, the arched truss, and the tension cord, so that the camber of the bridge may be increased or diminished by the adjustment of these blocks, in connexion with the tension cord, so as to increase the strength of the bridge by lessening the strain on any one point by distributing it to many points by means of the adjustable blocks. 2d, Constructing and arranging the blocks which sustain the tension braces of the suspension truss, so that they will slide or traverse on the string pieces, so as to equalize, distribute, and proportion the load more uniformly and over a larger portion of the bridge. 3d, Supporting the floor timbers alternately or successively by the arch and suspension trusses."

87. For a *Machine for Engraving Calico Printers' Rollers;* John and Thomas Hope, Providence, Rhode Island.

Claim.—"The combination and arrangement of the two sets of measuring markers, the hold-back rods and roller, with plane surface table, the same being not only to enable the design to be transferred, it being brought forward in regular sections, but to be maintained flatly upon the table. Also, the two measuring indices, in combination with the large pulley and the shaft of the driving roller of the cylinder to be engraved. Also, the means of holding and moving the cylinder, so that it shall not only be rotated by pressure against its external surface, but may be readily either removed from or applied to its supports, the same consisting in employing a driving roller and a bearing roller at one end of the cylinder, in combination with two sets of bearing rollers made to extend into a groove around the cylinder, and to support such cylinder both laterally and longitudinally. Also, the arrangement of the pattern table, the tracer, and its carriage, the several other carriages, the mechanism for operating each, the wheel, its shafts, and the supports of the roller to be engraved, the whole constituting an improvement in engraving machinery and securing to it important advantages in operation as well as in construction."

88. For an *Improved Apparatus for Vessels to indicate their locality when they sink, and to supply a means of raising them;* Joseph Hyde, City of New York.

Claim.—"I am aware, that on some occasions in throwing guns, anchors, and other heavy articles overboard to lighten ships at sea, cords with floats have been previously attached, to indicate their locality when sunken, but I am not aware that buoys, specially provided, have ever been arranged and connected with a vessel or anything within it, so as to remain so connected and give out the connecting cord, to remain on the surface of the water as the vessel sinks, to indicate its locality and afford the means of forming the necessary connexion for raising the vessel, &c., to the surface, and, therefore, I do not claim, broadly, the use of floats to indicate the locality of sunken articles. I do not wish to be understood as limiting myself to the special construction of the buoys, nor to the special manner of arranging the cord which forms the connexion between the buoy and the socket or the hose, nor to the special construction of or mode of attaching the socket to the vessel or safe, nor to the mode of making the flexible bags or camels and hose, nor to the special construction of the grapple, as all these may be varied without changing the character of my invention. What I claim is, the mode of operation for indicating the locality of sunken vessels by means of a buoy or buoys connected and combined with the vessel by means of a cord or cords, or the equivalent therefor, attached to the buoy, and a windlass, or equivalent thereof, and connected with the vessel or some valuable within the same. Also, the mode of operation for connecting cables or chains with sunken vessels or articles therein by means of the socket, or any equivalent therefor, operated by the buoy cord."

89. For an *Improvement in Railroad Car Seats;* Ebenezer Jeffers, Dorchester, Mass.

Claim.—"I am aware that a chair seat has been so combined with its legs or supporting frame as to be capable of being rotated horizontally; I am also aware, that it is not uncommon to apply a table or other article to a stand by such devices as will admit of its being moved in either a horizontal or vertical direction. I therefore, do not claim such; but I do claim arranging the pedal, the bolt, and their locking recesses, together

and in the sector, and in the turning and stationary posts, as described, and so that by one single movement of the pedal, the sector and the turning post may be latched or unlatched simultaneously, so at to enable the chair to be operated."

90. For an *Improvement in Journal Box Alloys;* Benjamin F. Lawton, M. D., Troy, New York.

"My improved alloy consists of wrought iron, copper, tin, and arsenic, combined in various proportions, according to the degree of hardness, toughness, or other quality it is desired to make it a superior alloy or box metal."

Claim.—"The aforesaid alloy or box metal as a new material, for the purpose of forming boxes, journals, axles, and all other rubbing surfaces of the moving parts of machinery."

91. For an *Improvement in Journal Box Alloys;* Benjamin F. Lawton, M. D., Troy, New York.

"My improved compound box metal or alloy consists of cast steel, nickel, copper, and tin, prepared and admixed in various proportions, according to the requisite degree of toughness or other quality that may be desired to make it a superior box metal or alloy."

Claim.—"The aforesaid box metal or alloy as an improved material for the purposes of forming locomotive crank boxes, piston rings, journals, boxes, axles, and other rubbing surfaces of the moving parts of machinery."

92. For an *Improvement in Warm Bath Apparatus;* Louis H. Lefebore, New Orleans, Louisiana.

Claim.—"The portable steam bath apparatus, composed of a double generator, so arranged, that the products generated in the two compartments may be conveyed to the bath mingled or separated, of a bag and of a connecting pipe, each of said parts constructed and arranged as described."

93. For an *Improvement in Pressure Gauges;* John Matthews, Jr., City of N. Y.

"My invention consists in certain improvements in instruments for ascertaining the pressure of gases and fluids, and is chiefly designed for a steam pressure or vacuum gauge."

Claim.—"The construction of a gauge tube in the manner set forth, that is to say, having off-sets thrown out along one side for the purpose substantially as described."

94. For an *Improvement in Percussion Projectiles;* Augustus McBurth, Elizabeth, New Jersey.

"My invention consists in the construction of a bomb shell, (or missile,) that contains all the properties of the cannon ball, together with a more destructive and certain effect than the bomb shell."

Claim.—"The improvement in bomb shells or missiles having four arms and eight flutes with sharp edges, in the manner and for the purpose substantially as described. Also, a rod to pass through the shell in a longitudinal course for the purpose set forth. And, also, a hammer with a flat spring attached, together with a spiral spring, as substantially shown and described."

95. For a *Hand Stamp;* Stephen P. Ruggles, Boston, Massachusetts.

"The nature of my invention relates, first, to the manner of connecting a plate to the handle by means of a screw cap to facilitate a change of plates; also, in holding the ball to the socket by a pin and its accompanying parts to prevent the spring from coming out."

Claim.—"The connecting of an electrotype plate to the handle of the stamp by means of a screw cap, for the purpose of facilitating the removing and replacing of the electrotype or portions thereof as set forth. Also, the combination of devices for holding the bed plate to the shank, so as to preserve the ball and socket or yielding point, prevent them from being separated, and to keep the coiled spring in place, the same consisting of the flanches on the bed plate with the holes therein, the large opening in the shank piece, and the pin passing respectively through them."

96. For an *Improvement in Railroad Car Seats;* Albert M. Smith, Rochester, N. Y.

Claim.—"I do not claim the form or shape of the back or seat part of the car seat, as

they are in common use; but I do claim the constructing and arranging of the car seat, so that the whole back of sufficient width and shape best adapted to support the body of a person for day riding, if changed either side of the seat to ride either way, can be reversed, the outside turned inside, thereby, and at the same time, raised high enough to support the head and body equally well for night riding by means of and in combination with the different devices, or their equivalents necessary for the purpose."

97. For an *Improvement in Horse Yokes;* John Woodward, Wilmot Flat, N. H.

Claim.—"I do not claim a horse yoke consisting of two eveners or horizontal bars, a connecting or vertical bar, two sets of harness and ham connexions, arranged at the upper and lower ends of the harness, such being represented in the patent of Elijah H. Dantforth, granted July 28, 1846; but I do claim my improved mode of constructing and arranging the hame connexions with respect to a single beam, whereby such hame connexions may be attached to the middle of the hames instead of at their ends, and thereby render but one bar or bearer necessary to connect the hames and the pole of a carriage."

98. For an *Improved Door Knob;* Alonzo E. Young, Dorchester, Massachusetts, Assignor to self and Mark Worthly, Boston, Massachusetts.

Claim.—"What I claim, is, the sliding clutch and its attachments applied to the shank, and the socket, and the movable knob."

99. For an *Improvement in Breech Loading Magazine Fire Arms;* John Swyney, Charlestown, Massachusetts, Assignor to self and James Dandridge, Boston, Mass.

Claim.—"The carrier, its spring, in combination with the magazine or tube, for the purpose of bringing a cap from the magazine downwards or into line with the rammer. Also, the rammer, in combination with the rammer and the mechanism by which they are connected, so as to operate together, as described, such mechanism consisting in part of the rod and the lever. Also, combining with the charge chamber and the magazine the intermediate chamber or carrier, said charge chamber and carrier being connected with and operated simultaneously by the guard."

100. For a *Machine for Sawing Shingles;* Charles Ketcham, Assignor to Charles G. Judd and Andrew Oliver, Penn Yan, New York.

Claim.—"1st, the feeding trough for containing the shingle or stock block, constructed as described, and arranged in relation to the means for feeding and the means for cutting. 2d, The receiving trough, having the grooves in it to receive each shingle while being cut, and holding them sufficiently to permit their easy and ready removal from the saws in compact and orderly condition. 3d, The arrangement of the adjustable inclined levers by pressure exerted in the line of the edge of the shingle being cut by means of the rollers, or their equivalents, held and moved substantially as stated, in contradistinction to the holding of the block by lateral and end pressure, as is usual in shingle making machines, so that the shingle being cut is neither pressed upon the sides of the saw, as must occur when lateral pressure is used, nor the block upon the teeth of the saws, as must occur when end pressure is made."

101. For an *Improvement in Corn and Cob Mills;* Daniel S. James, New Market, Virginia, Assignor to self J. B. White, and J. W. McIntire, Dinwiddie Co., Va.

Claim.—"I make no claim to any of the parts of the machine separately considered, neither do I claim the simultaneous rotation of shell and burr, nor the means by which the same is produced, as such is not new. But I do claim suspending the rotary shell by an upper arch upon a shoulder of the main spindle, when the said shell is connected at bottom with the burr, as described, and the moving power applied directly to the shell, whereby friction is greatly diminished and consequent facility of operation attained."

102. For a *Machine for Paging Books, &c.;* William C. Demain, Assignor to A. B. Ely, Boston, Massachusetts.

Claim.—"Operating the numbering wheels by means of the springs, whereby the first wheel is caused to actuate all the others, and the operation of the machine is rendered automatic, in the manner set forth. 2d, The repeating wheel operating according to the form and frequency of the notches therein, substantially as described. 3d, I claim the

drum with its notches, in combination with the numbering wheels. 4th, The gate, in combination with the numbering wheels and the parts which set them in motion."

103. For a *Burglars' Alarm;* Albert Bingham, Assignor to self and Andrew J. Bailey, Boston, Massachusetts.

Claim.—"I do not claim combining with the match holder a roughened surface for the match to rub against, but I claim arranging the friction surface when applied to a spring, bent as set forth, at an angle with the match holder or its path of movement, as described, in order to facilitate the ignition of the match when the holder is in movement. I also claim making the friction surface to revolve, as described, in order that a fresh portion of the surface may be exposed to the match whenever any part of the surface becomes worn or unfit for use. I do not claim the combination of an alarm apparatus, a movable match holder or friction surface, and a lamp, nor the combination therewith of a contrivance for casting the extinguisher off the wick tube of the lamp; but I do claim, the above described arrangement of the match holder, cast-off lever, and hammer rod of the escapement, whereby, while the match holder is retracted, the escapement apparatus will be controlled as described, but during the forward motion of the match holder, not only will the cast-off lever be tilted, so as to throw the extinguisher off the wick tube, but the escapement set free, so as to enable the alarm mechanism to operate and strike the hammer with repeated strokes upon the bell."

104. For an *Improvement in Folding Chairs;* John Cram, Assignor to self and John S. Cram, Boston, Massachusetts.

Claim.—"Combining the platform or seat with the back legs by means of the turning or front legs, and the connecting links or bars, and so that said seat or platform may be either turned down horizontally, so as to be supported on both sets of legs, or they and the seat be folded together."

105. For an *Improvement in Harvesters;* Charles Bradfield, Philadelphia, Pa.

Claim.—"The arrangement of the pulleys on and near the axle, and the finger and cutter bar underneath the axle, when the cutters are operated from said pulleys through the intervention of the endless belt, cranks, pitman, and connecting rod, as set forth."

106. For an *Improvement in Curtain Rollers;* Dexter H. Chamberlain, West Roxbury, Massachusetts.

Claim.—"Attaching the spool directly to the spindle, and causing it to revolve with the curtain rod, where the spool is forced towards the jamb by the spring."

107. For an *Improvement in Window Shades;* John J. Crooke, City of N. Y.

Claim.—"So constructing and hanging a window shade, that the roller thereof shall be capable of being raised and lowered, and, at the same time, shall roll or unroll the shade, and this without interfering with the fixtures for raising the bottom of the shade in the ordinary manner, as described."

AUGUST 28.

108. For an *Improvement in Traps for Catching Animals;* Lucius B. Bailey, Watertown, Connecticut.

Claim.—"The application of the ratchet bar and pawl to the trap, for the purpose of rendering it capable of confining the animal after being caught underthe drop or fall, as set forth."

109. For an *Improvement in Cotton Gin Saws;* A. D. Brown, Columbus, Georgia, Assignor to Margaret L. Brown, Opalika, Alabama.

"This invention consists in arranging the teeth of the saws in a series of curves eccentric to their axes, or what is equivalent, in a series of tangential lines; by this means, with a proper arrangement of the saws relatively to each other, it is rendered impossible for any two saws to catch the same fibre across a rib, and thereby cut or break it, and a peculiar degree of facility is provided for the clearing of the saws by the brush."

Claim.—"I am aware that cotton gin saws have previously been constructed in segments of circles, but I regard that as a totally different arrangement, as the teeth are arranged in the same circle, and I do not claim any such arrangement; but I claim arranging the teeth in a series of curves eccentric to the axis of the saws, or what is equivalent, in a series of tangential lines, as set forth."

110. For a *Machine for Splitting Fire-Wood;* Wm. O. Bisbee, Camden, N. J.

Claim.—"I do not wish to confine myself to the exact form or method of operating the machine or to the exact number of vertical knives shown; but what I claim is, the vertical knives, as arranged with their edges a distance in advance of each other and their sides at different angles, so as to act effectually as a means of rifting wood."

111. For an *Improvement in Preparations of Wool Oil;* Thomas Barrows, Dedham, Massachusetts.

Claim.—"In basing my claim of invention or improvement on the use of mucilaginous matter, I do not include aluminous or gelatinous matter of animal origin, nor ammoniacal, or other alkaline emulsions which have been before used, but restrict myself to the use of those watery solutions of mucilage from plants and seeds, whose muculent character is distinguished from the gum or glue-like character of those substances heretofore used by not drying out from the mixture with the oil when on the fibres of the wool. I use any of the oils adapted to oiling wool in mixture with mucilage, although such mixture, by rest, for a longer or a shorter time, will become separated into oil, which floats, and mucilage which subsides, but prefer the prepared oleic acid or "oleine" mixture, as it often remains uniform several days. I, however, lay no claim to the application of oleic as described; but what I claim as my invention or discovery for the treatment and imbuing of wool, during or previous to its manufacture into yarn or cloth, is the application thereto of mucilage possessing an attraction for water, such being found in sea mosses and allied vegetable productions, or in various seeds, such as flaxseed, it being used either alone or in mixture with an oil or some other material."

112. For an *Improvement in Carriages;* John L. Cisco, Xenia, Ohio.

Claim.—"The application of the apparatus described in turning carriages short, consisting of the half circle bars or plates and sliding bar attached to the running gear, as described, in connexion with the fifth wheels, by which, in turning short, the body is carried out of the way of the wheels, in manner as described, or any other apparatus substantially the same producing the same effect."

113. For an *Improved Method of Facilitating the Removal of Incrustation from Steam Boilers;* Frederick P. Dimpfel, Philadelphia, Pennsylvania.

Claim.—"The method, substantially as described, of facilitating the removal of incrustation in steam boilers, by inducing breaks in the circle of the incrustation in the manner described."

114. For an *Improved Vise;* Robert W. and Daniel Davis, Yellow Springs, Ohio.

Claim.—"We are aware that parallel vises have been heretofore constructed with cross levers and ratchet movement, and do not claim merely such as our invention; but what we claim is, our improved arrangement of the sliding ratch beam, pawl, and the detachable weighted key, and the cam, all constructed and operated as described."

115. For an *Improvement in Harvester Rakes;* Oliver C. Green, Belleville, Ill.

"The nature of my invention consists in such an arrangement of the devices operating, and the mode of constructing a rake applicable to any of the harvesting machines now in use, that a side delivery of the cut grain shall be effected in the most simple and efficient manner by an apparatus free from complexity, extra weight, or waste of propelling power of the team employed."

Claim.—"I am aware that the delivery of grain at the right angles to the line of draft of the team has been accomplished by means of a rake traveling across the platform, in conjunction with a second rake turning in a segment of a circle, and, therefore, I do not claim the described delivery of grain irrespective of the means by which it is accomplished; but I claim the combination of the rake, sliding head, way or guide, fender board, and incline-plane, or severally of their equivalents, operating in the manner and for the purpose set forth, so that with a single rake, I accomplish the raking of grain across the platform and the delivery thereof in the manner substantially as set forth."

116. For an *Improved Sash Fastener;* Asahel Gilbert, Jr., Lowell, Massachusetts.

Claim.—"The hinged cross bars, having split knob handles, serving to disengage the fastening on both sides of the sash and to raise and lower the sash."

117. For a *Rotary Wood Splitting Machine;* G. W. B. Gedney, City of New York.

Claim.—"The machine described for splitting wood, consisting of the V grooved

knives acting upon the wood, as described, having openings in their apex to receive the clearers, as specified, and in combination therewith, the fingers for holding down the rear end of the wood to be split. Also, the mode of attaching the knives by the groove, e', at their back, and an overreaching flanch, e'', by which the resisting strain tends to hold the knife in place, as specified, without bringing the strain upon the bolt by which it is fastened."

118. For an *Improvement in Ploughs;* John L. Gill, Columbus, Ohio.

"The nature of my invention relates to the construction of a plough, the mould board of which is of sheet, and the share, sheath, and land-side of cast iron, arranged and united as described."

Claim.—"I am aware that a combined steel and cast iron mould board has been used, and, also, that a cast standard has been used; these I do not claim, neither do I claim any of the parts used separately; but what I do claim as new, is a plough composed of a steel mould board, cast iron share, sheath, and land-side where the several parts are arranged as set forth."

119. For an *Improvement in Lime Kilns;* Daniel Herr, Pequea, Lancaster, Pa.

"The nature of my invention consists in so constructing permanent arches for lime kilns, that the fire may have free access to the limestone from beneath, and, at the same time, the loose lime and fragments, in falling through the grate ways of the arch, shall not fall upon and deaden the fire."

Claim.—"Making the arch of the kiln with two series of arched channeled ribs, so arranged, that the outer ribs shall extend over and across the spaces left between the inner ribs, and, at the same time, leave sufficient space between the outer and inner ribs for the fire and heat to pass into the limestone, whereby the fragments and loose lime are all prevented from falling into the fire, and are conducted down the channels into the proper receptacle below."

120. For an *Improved Hand Stamp;* Horace Holt, Winchester, Massachusetts.

Claim.—"A hand stamp, in which the stamp is inked and the impression effected by the movement of the stamp in one vertical plane, the ink pan or fountain being arranged directly under the stamp, and provided with a cover, which can be moved away from or upon the said pan or fountain, thus serving both as a cover to the ink receptacle and as a platen to the article to be printed."

121. For an *Improvement in Scythe Fastening;* Benjamin F. Joslyn, Worcester, Massachusetts.

Claim.—"The arrangement of the lever as applied to the hoop, as set forth, as a means of securing the shank of the scythe to the end of the snath."

122. For an *Improvement in Weighing Scales;* John L. McPherson, New Vienna, O.

Claim.—"I am aware, that various things have been made tubular or hollow for the purposes of strength with lightness of metal; this I do not claim; but what I do claim is, in combination with the shafts, the fifth or guard fulcra, which prevents the platform from careening should the weight be unequally distributed on said platform, without in the least impairing its correct weighing, as set forth."

123. For an *Improved Regulating Valve for Steam Engines;* E. G. Russell, Ravenna, Ohio.

"This invention consists in a valve of peculiar construction, which is acted upon by the pressure of steam, in such a manner as to cause the area of its opening to be increased or diminished by any tendency to diminished or increased velocity."

Claim.—"I do not claim to be the first inventor of a regulating valve, the area of whose opening is increased or diminished by any tendency of increased or diminished velocity; but what I claim is, the hollow cylindrical valve, open at one end and closed at the other, fitted in a cylindrical seat, with its closed end on the inlet side of the said seat, and provided with a slot at one side near the closed end, to allow the steam to pass through its interior, and having a spring applied to balance the excess of pressure on the inlet side, and to give a tendency to open the valve, the whole operating as described."

124. For an *Improvement in Sewing Machine Cases;* Francis A. Ross and Wm. H. Marshall, City of New York.

Claim.—"Making the case in the form of a cabinet, which, when opened, will afford

space for operating the machine by the treadle, and will form a table for the work, by raising the leaves and supporting them by the doors of the cabinet, when thrown open, in the manner described. We, also, claim the construction of the folding top, which, when open, furnishes drawers and shelf for the convenience of the operator, as described."

125. For an *Improvement in Shutters or Blinds for Stores;* David Rohan, Cincinnati, Ohio.

"The nature of this invention consists in an arrangement of sliding shutters, which, in combination with a bolt column, can be used for shutting and closing stores or warehouses entirely or partially, as specified."

Claim.—"Hanging the shutters together by mitred joints, so that when closed, the joints or hinges may be concealed. Also, in connexion with the mitred shutters, the hinged piece, which serves the double purpose of a post against which said shutters abut and to which they may be locked when the front is closed, and also as a finish to one of the shutters when it is run back, as represented."

126. For a *Machine for Trimming Books;* M. Riehl, Cincinnati, Ohio.

"The nature of my invention consists in the peculiar mode of hanging the knife and the mode of operating the same."

Claim.—"Hanging or attaching the knife to the cross piece of the uprights by the arms, as shown, whereby a drawing or oblique cut of the knife is obtained, and operating the knife by means of the worm wheel, screw, and connecting bar."

127. For an *Improvement in Brick Machines;* Levi Till, Sandusky, Ohio.

Claim.—"1st, The use of the air pump in combination with the perforated pressers, by which the air is exhausted from the clay while under pressure, as stated, and not otherwise. 2d, The device of the diagonal slots, in combination with alternating with the pressers, by which all the excess of clay may escape, and is discharged on one side (and not on both) of the machine."

128. For an *Improvement in Wagons;* James Parsons, Dublin, Indiana.

Claim.—"1st, The arrangement of the side pieces or ways resting upon the elevating blocks near the outer end of the bolster, thereby gaining a greater width between them than is attained in other wagons constructed for similar purposes, thus giving space for loading, if raised on a plank or platform, to raise partly above and between them, if necessary, to clear the ground in hauling; also, the manner of their forming the connexion between the forward and hind wheels, by passing or sliding through the brace bands and the mortises or slots of the arch. 2d, In the structure of cast arch, the open mortises or slots and their uses, that when the arch and wrought axle-tree combined, as represented, when supported by the hind wheels, the mortises or slots will be brought nearly or quite in a horizontal position for the reception of the side pieces or ways, as described, thus serving the purposes of coupling the wagon long or short, to suit circumstances. 3d, The peculiar adaptation of the oblong band of the braces, through which the side pieces or ways slide and the hind elevating blocks pass, and the blocks being held in their proper position by the bands dropping into the notches of elevating blocks, thus giving them the sliding motion upon the side pieces or ways, and the side pieces or ways are permitted to slide freely through them and under the blocks, and from thence they form a connexion with the cast arch and wrought axle-tree by a stirrup firmly binding them together. 4th, Also the manner of so arranging the hind elevating blocks, as to give them the sliding principle, as previously described, and the ears on opposite sides, thus rendering them adjustable in coupling the wagon long or short, by means of the steady or toggle pins, and, again, by their holding in connexion with the braces, the arch in a perpendicular position, by the upper part of the casting of mortises or slots being notched into the elevating blocks as described."

129. For an *Improvement in the Mechanism for Changing Harvesters from Reapers to Mowers, &c.;* Robert Beans, Johnsville, Pennsylvania.

Claim.—"The combination of the lever and connecting rod with any means of altering the height of the frame above the cutter bar, for the purpose of retaining the same relations between the stroke of the knives and the teeth or fingers, although the distance between the head of the cutter bar and the crank be varied in so doing, as set forth."

130. For an *Improvement in Machines for Cutting Standing Cotton Stalks;* S. Bowerman, Detroit, Michigan.

Claim.—"The combination of the block, knife, rods, springs, rack, and cog-wheel, when arranged for the purposes specified and shown."

131. For an *Improvement in Ships' Windlasses;* James Emerson, Worcester, Mass.

Claim.—"The gearing and the ratchet on the shaft, when arranged substantially as shown, for the purpose of operating the shaft of the windlass with a quick, or slow, or vibrating motion, and with a corresponding degree of power, one set of gear wheels being independent of the other set, and allowing the windlass, in case of the breaking of one, to be operated by the other."

132. For an *Improvement in Breech Loading Fire Arms;* Benjamin F. Joslyn, Worcester, Massachusetts.

Claim.—"The combining of the cone-headed pin and two or more expanding rings with the radial breech loading fire arms."

133. For an *Improvement in Grain and Grass Harvesters;* John Thompson Clifton, City of New York.

"My invention consists in the extension of the axle in reaping machines across the machine at such height, that the grain or grass may be gathered and discharged under the axle."

Claim.—"Discharging the grain from the platform between the platform and the driving wheel and under its axle, when the same is done in connexion with a pair of wheels whose axle extends across the machine, as described."

134. For an *Improvement in Straw Cutters;* John A. Thompson, Cayuga, N. Y.

Claim.—"Giving the cutting disk of a straw cutter a combined rotary and reciprocating motion, in the manner set forth."

135. For an *Improved Collapsible Boat;* Nathan Thompson, Jr., Williamsburgh, N. Y.; patented in England, February 23, 1855.

Claim.—"1st. The combination of hinged flaps or bottom pieces with elastic or flexible sides, in the manner and for the purposes specified. 2d, The combination of hinged flaps with a centre keelson and flexible or elastic sides, as set forth. 3d, I claim either of these combinations in connexion with water-proof fabric for closing and securing the joints between the several parts, applied substantially as specified. 4th. I claim a hinged swinging brace, in combination with a hinged thwart thereto attached, and, lastly, I claim a sliding joint, in combination with the bow and stern hinges, whereby the effective length of a keelson or flaps may be altered, so as to suit the expanded and collapsed states of the boat."

136. For a *Machine for Cutting Irregular Forms;* P. H. Wait, Barkersville, N. Y.

Claim.—"I do not claim the pattern or the means of turning irregular formed articles by means of a pattern, for this has been previously done in various ways; but what I claim is, the employment or use of two vibrating or oscillating frames, placed upon a rod or shaft and operated by means of the pattern bearing against the sliding rollers or disks, said pattern, as it rotates, moving the 'stuff' at the upper parts of the frames towards and from the cutter disk, the cutter disk and rollers or disks being moved by means of the screw-rod or shaft and nut, as shown."

137. For an *Improvement in Reaping and Mowing Machines;* Henry Waterman, Williamsburgh, New York.

Claim.—"I do not claim the advancing and retreating curvilinear motion of the cutter bar, but I claim the combination of the two sets of knives described with the curvilinear motion of the cutter bar. Also, the elastic fingers, in combination with the curvilinear motion of the cutter bar. Also, collecting and depositing the grain by the revolving cradles by the weight of the grain laid upon them by the reel."

138. For an *Improvement in Vault Lights;* Wm. P. Walter and Jacob Green, Philadelphia, Pennsylvania.

Claim.—"We are aware, that it is a very common device to avail one's self of the expansive and contracting properties of metal in fitting metal rims tightly around various articles, and we are also aware that it is not a new device to unite silicious com-

pounds to metal by casting the former, in a molten state, about the latter, as, for instance, in the manufacture of porcelain or glass door knobs with metal shanks; we, therefore, disclaim both of these as broad devices. But what we do claim is, the described improvement in the construction of vault lights, namely, casting the molten glass directly into the metal frame while in a heated state, said metal frame being grooved internally, so that when it contracts on cooling, and contracting as it does, more than the glass, this groove shall bind the glass lens tightly in its place and so retain it."

139. For an *Improved Flask for Moulding Bath Tubs;* John Demarest, Assignor to "The J. L. Mott Iron Works," Mott Haven, New York.

Claim.—"Connecting, by means of a brace or braces, the sides of the drag or first section, and of the cope or third section of flasks, for casting bath tubs or other large and thin hollow vessels, substantially as described, in combination with the clamps and adjusting screws, or their equivalents, which embrace and act upon the sides of the cheek or second section of the flask. And, also, recessing the upper edge of the wings on the inside of the cheek or second section of the flask back of the inner edge, as specified."

140. For an *Improvement in Ink-Stands;* Albert Bingham, Assignor to self and Andrew J. Bailey, Boston, Massachusetts.

Claim.—"Arranging and combining with the hinged cover of the pen port, substantially as described, the bow lever, whereby the cover may be raised, under circumstances and in the manner specified."

Re-Issues for August, 1855.

1. For an *Improvement in Hot Water Apparatus;* John Brown, City of New York; patent dated May 30, 1854; re-issue dated August 14, 1855.

Claim.—"Connecting the ends of the horizontal or nearly horizontal water pipes of hot water warming apparatus, by means of return bends or elbows of less calibre, and entering within the end or ends of such pipe or pipes. Also, making each horizontal or nearly horizontal pipe having the bend or elbow at one end of reduced calibre with the calibres at top in the same line, whether made in one piece or the bend or elbow separate and then united, the said elbow being connected with the next pipe above it by entering the end thereof. And I claim the construction and arrangement of the apparatus for the purpose as specified."

2. For an *Improvement in Bathing Tubs;* Jordan L. Mott, Mott Haven, New York; patent dated September 27, 1853; re-issue dated August 14, 1855.

Claim.—"I do not claim broadly as of my invention the connexion of the hot and cold water pipes of a vessel, so as to discharge hot and cold water together, as this has before been done by a pipe or pipes coupled with the bottom of the vessel and discharging upwards; nor do I claim broadly the use of an overflow pipe for carrying off the water and preventing the water in the tub from overflowing, as a separate device has before been used for this purpose, but, when so used, it was so connected with the waste and supply pipes, as to necessitate the use of a valve within the water pipe or a double coupling therewith, together with all its attendant disadvantages. And, although I have described my said improvements in connexion with and as applied to a bath tub, it will be obvious, from the foregoing, that they are equally applicable to other and analogous vessels, such as wash-basins, wash-tubs or vats, sinks for kitchens, &c. What I claim is the before described mode of combining with a bathing tub or other like vessel, either one or both of the channel ways, and making part of the tub or vessel (when constructed) one of which channel ways connects the overflow and waste or discharge holes with the waste pipe, and the other channel way is adapted to the insertion of the hot and cold water pipes, and discharging the hot and cold water together at or near the bottom of the vessel and in a horizontal or nearly horizontal direction."

3. For a *Method of Warming and Ventilating Buildings;* Henry Rutland, Coburg, Canada West.

Claim.—"1st, The mode herein described of warming and ventilating buildings, railroad cars, and apartments of every known description, the same consisting in introducing the air from without, by conducting under the floor of the building or apartment

and directly under the air warmer or ventilator, for the purpose of being warmed for distribution, the air after being thus warmed, rising in a central or otherwise convenient apartment or passage, and thence being admitted into the various rooms of the building or into the apartment near the ceiling or roof, without the aid of pipes, and thence passing downwards and through openings in the lower part of the rooms or apartment, and thence outwards through the various channels provided, connected with the foul air shaft. I do not claim simply introducing warm air at the top of a room and discharging it at the bottom, but only intended to claim this when effected in the manner as above described. 2d, The arrangement of the radiating pipes or flues of the air warmer, in combination with the fire chamber situated within or between them. 3d, In combination with the elevated air chamber and flues of the air warmer, the arrangement of the openings for admitting heated air above the fire to complete combustion. 4th, The construction of the fire grate, viz: with one or more grates of cylindrical or other form raised above the ordinary grate-floor, said raised grates being capped or covered in such manner, as to protect the vertical bars from the fuel. 5th, The mode of conducting the air into the pure air-shafts, whatever may be the direction of the wind or of the external currents of air, by placing a swinging valve or shutter at the mouth of said shafts. 6th, So constructing or placing the mouths of the pure air-shafts for the ventilation of railroad cars, that by the motion of the car, the incoming pure air may be increased in quantity."

4. For an *Improvement in Lanterns;* Hugh Sangster and James Sangster, Buffalo, New York; patent dated June, 10th, 1851; re-issue dated August 21st, 1855.

Claim.—"We do not claim fastening lamps to lanterns by spring catches, nor do we claim attaching said catches to the upper part of the lamp and extending them down, so as to spring outward over a flanch in the lantern; but we do claim constructing and arranging the spring catches to cause the attachment of the lamp to the lantern by the operation of pressing the lantern down upon the spring catches. Also, arranging the thumb piece within the flanch at the base of the lamp by extending the springs towards each other horizontally, and thus forming the elbow-catch to rest against the shoulder on the flanch of the lantern."

5. For a *Method of Closing and Opening Gates;* Wm. G. Phillips, Newport, Delaware; patent dated March 7, 1851; re-issue dated August 21, 1855.

Claim.—"A double span rotating gate, opening and closing by an intermittent rotating motion in one direction only, said motion being derived through lifting pieces or levers, cam planes, weights, or cords, or their equivalent."

6. For an *Improvement in Hinges;* Charles Parker, Meriden, Connecticut, Assignee of Wm. Baker, Utica, New York; patent dated April 13, 1852; re-issue dated August 28, 1855.

Claim.—"I do not claim as new, simply constructing the window blind hinge with its screw plate, so arranged as to be screwed to the back of the blind and the outside of the window-casing, but I claim the bridge or inclined plane at the base of the pin, and the corresponding elongation of the eye operating and in connexion with the hook and catch attached and connected in the manner described. Also, the elongated or enlarged eye, independently of its combination with the bridge, for giving the lateral motion to the blind to effect the disengagement of the lower catch. Also, so placing the catches on the two ports of the hinge, as to cause the strains produced by the wind or otherwise, to act directly upon the screws, whereby the pin and eye are relieved."

Designs for August, 1855.

1. For *Labels on Bottles and Jars;* Wm. A. Rogers, Decatur, Alabama; August 7, 1855.

Claim.—"The construction of the design and the fashioning of the letters and the marking out of the same, so as to leave them on the glass in a permanent form."

2. For *Ornamenting Stove Plates;* Samuel W. Gibbs, Albany, New York, Assignor to A. H. McArthur & Co., Hudson, New York; August 14, 1855.

Claim.—"The combination and arrangement of ornamental figures and forms represented in the accompanying drawings."

3. For *Cooking Stoves;* Apollos Richmond, Assignor to A. C. Barstow & Co, Providence, Rhode Island; August 21, 1855.

Claim.—"The design, consisting of the ornamental plan and scolloped mouldings and figures of harps or ancient lyres."

4. For *Iron Railings;* Minard H. Fowler and Enoch Jacobs, Cincinnati, Ohio.

Claim.—"The ornamental design and configuration of looped bars and rosettes, balls and pickets."

5. For *Stoves and Fire-Places;* Winslow Ames, Nashua, New Hampshire; August 28, 1855.

Claim.—"The ornamental design as exhibited in the accompanying drawings, or more particularly, that of the front plate and the end plate, the hearth plate, the leg, the top plate, and the blower."

6. For *Cooking Stoves;* Russell Wheeler and Stephen A. Bailey, Utica, New York; August 28, 1855.

Claim.—"The configuration of surface and combination of ornaments."

7. For *Portable Fire-Places;* Winslow Ames, Nashua, New Hampshire; August 28, 1855.

Claim.—The design of the front of the stove, or, more particularly, that of the urn, the front plate, the upper blower, the fender, and the lower blower."

8. For *Cooking Stoves;* Conrad Harris and Paul Wm. Yoiner, Cincinnati, Ohio, Assignors to A. Bradley, Pittsburgh, Pennsylvania; August 28, 1855.

Claim.—"The design of the ornaments on the several parts of the cooking stove."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the means of Realizing the Advantages of the Air-Engine. By William John Macquorn Rankine, Civil Engineer, F.R.SS. Lond. and Edin., &c.*

[Read to the British Association for the Advancement of Science, Section G, at Liverpool, September, 1854.]

Section I. Summary of the Laws of the Mutual Relations of Heat and Mechanical Power, and of the Theoretical Efficiency of Thermo-Dynamic Engines.

1. The principal object of this paper is to explain the advantages of certain improvements in air-engines, and the reasons for believing that, with these improvements, such engines will be found to be the most economical means of developing motive power by the agency of heat. For this purpose, it is necessary, in the first place, to state briefly the general principles which have been established by the joint agency of reasoning and experiment respecting the mutual relations of heat and motive power, and which are applicable to steam, air, and all substances whatsoever.

It is a matter of ordinary observation, that heat, by expanding bodies, is a source of mechanical power, and conversely, that mechanical power being expended either in compressing bodies, or in producing friction, is a source of heat.

The general rules according to which these phenomena take place, have for some time been determined empirically, with more or less pre-

* From the Edin. Philos. Jour., January, 1855.

cision, for certain particular substances—for example, for steam ; but all systematic knowledge respecting them, as they affect all substances whatsoever, is deducible from two laws—that of the mutual convertibility of heat and mechanical power, and that of the efficiency of thermo-dynamic engines ; the term *thermo-dynamic engine* being used to denote any body, or assemblage of bodies, which produces mechanical power from heat.

2. The Law of the Mutual Convertibility of Heat and Mechanical Power is this: *That when mechanical power is produced by the expenditure of heat, a quantity of heat disappears bearing a fixed proportion to the power produced; and conversely, that when heat is produced by the expenditure of mechanical power, the quantity of heat produced bears a fixed proportion to the power expended.*

This law was believed, and reasoned from, by some inquirers before it was proved by experiment ; but being inconsistent with the formerly prevalent hypothesis of the existence of a peculiar substance as the cause of the phenomena of heat, it was recognised by few, until Mr. Joule, by experiments on the production of heat by the friction of the particles of various substances, solid, liquid, and gaseous, not only demonstrated the mutual convertibility of heat and mechanical power, but ascertained the fixed proportion which they bear to each other in cases of mutual conversion, which is this: The *unit of heat* generally employed in Britain—that is to say, so much heat as is sufficient to raise the temperature of *one pound of water*, at ordinary temperatures, by *one degree of Fahrenheit's thermometer*—requires for its production, and produces by its disappearance, in other words, is *equivalent to*, 772 *foot-pounds of mechanical power;* that is to say, so much mechanical power as is sufficient to lift a weight of one pound to a height of 772 feet.*

This quantity is known by the name of *Joule's equivalent*, and may be otherwise termed the *dynamical specific heat of liquid water* at ordinary atmospheric temperatures.

3. *Illustrations of this law.*—The dynamical specific heats of other substances may be determined either by direct experiment, or by ascertaining their ratios to that of water. For example, to heat one pound of atmospheric air, maintained at a constant volume, by one degree of Fahrenheit, requires the expenditure of

130·5 foot-pounds of mechanical power. †

This is the *real dynamical specific heat* of air. The *apparent dynamical specific heat* of one pound of air, *under constant pressure*, is (for a degree of Fahrenheit)

183·7 foot-pounds ; †

the difference, or 53·2 foot-pounds, being the mechanical power exerted by the air in expanding, so as to preserve the same pressure, notwithstanding the increase of its temperature by one degree. The apparent

* The value of Joule's equivalent for a degree of the centigrade scale is 772×9·5= 1389·6 foot-pounds. For French measures, viz., centigrade degrees, kilogrammes, and metres, it is 423·54 kilogrammetres. See Philosophical Transactions, 1850.

† It is worthy of remark, that the values of the specific heats of air were *predicted*, to a close approximation, by means of the Mechanical Theory of Heat, three years before they were ascertained by M. Regnault's experiments. (Trans. Roy. Soc. Edin., vol. xx.; Comptes Rendus, 1853.)

specific heat of air at constant pressure exceeds the real specific heat in the ratio of 1·41 : 1.

All quantities of heat may be thus expressed by equivalent quantities of mechanical power. The heat required to raise one pound of liquid water from the freezing to the boiling point, and to evaporate it at the latter temperature, is

$$1147°{\cdot}5 \times 772 = 885{,}870 \text{ foot-pounds},$$

of which $180°{\cdot}0 \times 772 = 138{,}960$ foot-pounds is what is termed *sensible heat*, or the heat employed in raising the temperature of the water, while the remainder,

$$967°{\cdot}5 \times 772 = 746{,}910 \text{ foot-pounds},$$

is the *latent heat of evaporation* of one pound of water at 212° Fahr., being the heat which disappears in overcoming the mutual attraction of the particles of water, and the external pressure under which it evaporates.

The mechanical equivalent of the available heat produced by *one pound* of such kinds of coal as are commonly used for engines in Britain may be taken on an average as equal to that of the heat required to raise *seven pounds of water* from the temperature of 50° to 212° Fahr., and to evaporate it at the latter temperature; that is to say, in round numbers,

6,000,000 foot-pounds.

The total heat produced by the combustion of the coal is considerably greater; but a portion necessarily escapes with the gases which ascend the chimney, and the above may be considered as a fair average estimate of the mechanical equivalent of that which is practically available.

4. *Mechanical Hypothesis respecting Heat.*—Heat, being convertible with mechanical power, is convertible also with the *vis-viva* of a body in motion. The British unit of heat, one degree of Fahrenheit in a pound of liquid water, is equivalent to the *vis-viva* of a mass weighing one pound, moving with the velocity of 223 feet per second, being the velocity acquired in falling through a height of 772 feet. A mass of water, of which each particle is in motion with this velocity, has its temperature elevated by one degree of Fahrenheit, upon the extinction of the motion, by the mutual friction of the particles.

It is natural to suppose that the motion, during this phenomenon, has not been really destroyed, but has been converted into revolutions of the particles in vortices or eddies too small to be perceptible by any of our modes of observation; and that the centrifugal force of such eddies is the cause of the tendency of hot bodies to expand, melt, and evaporate.

A hypothesis of this kind has long been entertained, and within the last few years it has been used so as to deduce the laws of the mechanical action of heat from the principles of ordinary mechanics, to a certain extent in anticipation of the results of experiment.* As those laws, however, have now been exactly ascertained by experiment, it must be borne in mind, that their certainty is in no way dependent on the truth of the hypothesis in question; the probability of the hypothesis being, on the contrary, dependent on the truth of the laws.

* See Transactions of the Royal Society of Edinburgh, vol. xx.

5. *Three-fold effect of Heat.*—The communication of heat to a substance produces, in general, three kinds of effects (setting aside chemical, electrical, and magnetic phenomena, as being foreign to the subject of the present paper):—

1st. An increase of temperature and expansive pressure; that is to say, an increased tendency to the communication of heat to other bodies, and to the development of mechanical power by expansion.

2d. A change of volume; which, under a constant pressure, is an *increase* for every substance, except some liquids near their freezing points.

3d. A change of molecular condition; as from the solid to the liquid state, or from the liquid or solid to the gaseous state, or any imperceptible change of molecular arrangement; the change to the gaseous state being always accompanied by an increase of volume.

The heat which produces the first of those effects is known by the name of *sensible heat*, as retaining the form of heat, and, in short, *making the body hotter*.

The heat which produces the second and third of those effects is called *latent heat*, as having disappeared in developing a mechanical effect, and being capable of reproduction by reversing the change which caused it to disappear.

Changes of volume are in general accompanied by changes of molecular arrangement or condition, perceptible or imperceptible. The *latent heat of expansion*, or of *evaporation*, therefore, as the case may be, consists partly of heat which disappears in overcoming external pressure, and partly of that which disappears in overcoming the mutual attraction of the particles of the body.

The latter forms by far the greater part of the *latent heat of evaporation*. For example, as already stated, there disappears, in evaporating one pound of water at 212°, a quantity of heat equivalent to . . . . . 746,910 foot-pounds.

The pressure of the steam produced is 2116·4 lb. on the square foot. Its volume is not known exactly by experiment, but is probably about 26½ cubic feet more than that of the liquid water. Multiplying these two quantities together, it appears that the heat expended in overcoming external pressure is equivalent to only . . . . 56,085 "

leaving . . . . . 690,825 "

for the mechanical equivalent of the heat which disappears in overcoming the mutual attraction of the particles of the water.

On the contrary, the latent heat of expansion of a permanent gas consists almost entirely of heat which disappears in overcoming the external pressure, that which disappears in overcoming the mutual attraction of the particles of the gas being comparatively very small; in fact, in all practical calculations respecting air-engines, the latter quantity may be altogether neglected without sensible error, and the latent heat of expansion of the air treated as the exact equivalent of the mechanical work performed by it in the act of expanding.

For example,—the product of the volume, in cubic feet, of one pound of air, at the temperature of 650° Fahrenheit, by its pressure in pounds

per square foot, is 59,074 foot-pounds. If that pound of air be expanded under pressure, to $1\frac{1}{2}$ times its original volume, and be still maintained at the constant temperature of 650°, by being supplied with heat from an external source, the work performed by it in expanding, will be 59,074 × hyperbolic-logarithm of $1\frac{1}{2} = 23{,}953$ foot-pounds; and this quantity will also be sensibly equal to the mechanical equivalent of the heat supplied, and which disappears during the expansion.

In considering the performance of any thermo-dynamic engine, it is evident that the heat which disappears in producing increase of volume under pressure, is to be regarded as the real source of power; as it is a portion of this heat which is actually converted into mechanical work, while the heat expanded in producing elevation of temperature, produces merely a *tendency* to the development of power.

6. *Mode of Operation of Thermo-dynamic Engines in general.*—The mode of operation of an elastic substance in performing mechanical work by the agency of heat, reduced to its simplest form, consists in the continued repetition, either upon the same portion of the substance, or upon a succession of equal and similar portions, of a cycle of four processes, which, taken together, constitute a single stroke of the engine.*

Process A. The substance is raised to an elevated temperature. This process may or may not involve an alteration of volume.

Process B. The substance, being maintained at the elevated temperature, increases in volume and propels a piston, or something equivalent to a piston. During this process heat disappears, and a supply of heat from without is provided equal in amount to the heat which disappears; so that the temperature does not fall.

Process C. The substance is cooled down to its original low temperature. This process, like the process A, may or may not be accompanied by a change of volume.

Process D. The substance, being maintained at its depressed temperature, is compressed, by the return of the piston, to its original volume. During this process, heat is produced; and in order that it may not elevate the temperature of the substance, and give rise to an increased pressure, impeding the return of the piston, it must be abstracted as quickly as produced, by some external means of refrigeration.

The substance, being now brought back to its original volume and temperature, is ready to undergo the cycle of processes anew, and so on *ad infinitum*; or otherwise, it is rejected, and a fresh portion of the substance employed for the next stroke. When the latter is the case, the operation of expelling the substance from the engine into the atmosphere, by the return of the piston, sometimes takes the place of the process D.

Sometimes, either of the processes, B, C, or D, is the first in the order of time. The cycle of processes, however, preserves the same order of rotation.

During the cycle of processes which has been described, the working substance alternately increases and diminishes in volume, in contact with a moving piston. During the increase of volume, the pressure of the substance against the piston communicates to the latter mechanical

* This cycle of processes was first described by Carnót (Reflexions sur la puissance motrice du feu); but his conclusions were vitiated by the assumption of the substantiality of heat.

power. During the diminution of volume, on the contrary, the piston expends mechanical power in compressing the working substance. The increase of volume takes place at a higher temperature, and therefore at a higher pressure, than the diminution of volume; consequently, the mechanical power communicated to the piston, exceeds that taken away from it. The surplus is the power of the engine, available for performing mechanical work.

7. *Efficiency of Thermo-dynamic Engines.*—The efficiency of a thermo-dynamic engine is the ratio which the available power bears to the mechanical equivalent of the whole heat expended.

If it were possible to construct an engine such, that the heat communicated to the working substance should entirely disappear, the power produced by that engine would be the exact equivalent of the heat expended: that is to say, 772 foot-pounds for each British unit of heat; and its efficiency would be represented by unity. According to the average estimate already stated, it would produce power to the amount of 6,000,000 foot-pounds for each pound of coal consumed; and, as a horse-power is 1,980,000 foot-pounds per hour, the consumption of coal would be 0·33 lb. per horse-power per hour. It is impossible, however, by any engine, to realize anything approaching to this degree of efficiency. This arises from two causes:—*first*, the *necessary loss* of heat, depending on the limits of temperature between which the engine works, according to a law which has been already referred to, and which will shortly be stated; and, *secondly*, the *waste* of heat and power arising from the engine's not fulfilling exactly the conditions prescribed by theory. When the *necessary loss* of heat alone is taken into account, the efficiency as determined by calculation, may be called the *Theoretical Maximum Efficiency* of the kind of engine under consideration. When the *waste* of heat and power is also allowed for, the result is the *actual efficiency* of the engine.

8. *Theoretical Conditions of Maximum Efficiency.*—The latent heat of increase of volume at an elevated temperature, being the direct source of the power of a thermo-dynamic engine, it is obvious, that, *cæteris paribus*, the more we reduce the other part of the expenditure of heat, namely, the heat which is expended in elevating the temperature of the working substance, the more nearly shall we attain to the maximum theoretical efficiency of the engine. It is theoretically possible to produce the required elevation of temperature, without any expenditure of heat. This is to be accomplished in two ways:—either by elevating the temperature of the substance by compression during the process A of the cycle: the power required for effecting such compression being obtained, during the process C, by depressing the temperature of the substance entirely by expansion; or otherwise, by storing up in a mass of some solid conducting material (called an economizer or regenerator,) the heat given out by the working substance, while its temperature is being depressed, during the process C, and employing the heat, so stored up, to produce the required elevation of temperature during the process A. This method of economizing heat was invented in 1816, by the Rev. Robert Stirling.

By one or other of those methods, it is theoretically possible to limit the expenditure of heat in a thermo-dynamic engine to that amount which

disappears during the process B of the cycle, in producing increase of volume at an elevated temperature. The heat which reappears during the process D, by the compression of the working substance at a low temperature, and which is carred away by refrigeration, constitutes the *necessary loss of heat;* and, if this be deducted from the whole heat expended, the remainder will be the theoretical maximum value of the heat which is permanently converted into mechanical power, and its ratio to the whole heat expended will be the theoretical maximum efficiency of the engine.

9. *Absolute Temperatures.*—The theoretical maximum efficiency of a thermo-dynamic engine, depends upon what are called the *absolute temperatures* of the working substance, during the second and fourth processes of the cycle; that is to say, the absolute temperatures at which heat in a theoretically perfect engine is received and abstracted respectively. Absolute temperatures are measured by the product of the pressure and volume of a given weight of a given perfect gas. A perfect gas is one in which the mutual attraction of the particles is insensible.

The *Absolute Zero of Heat* on a perfect gas thermometer, is that point on its scale which corresponds to total absence of heat; and from this point, absolute temperatures are understood to be reckoned, in the law stated in the next article.

According to the latest determination, from the experiments of Messrs. Joule and Thomson, the *Absolute Zero of Heat* does not differ by any amount appreciable in practice from the *Absolute Zero of Pressure*, being the temperature at which (if it were possible for a perfect gas to preserve its properties at so intense a degree of cold) the product of its pressure and volume would be reduced to nothing; and this point is 493° of Fah. below the temperature of melting ice; that is to say, 493°—32°= 461° below Fahrenheit's ordinary zero.*

10. The Law of the Maximum Efficiency of Thermo-dynamic Engines is expressed by the following proportion:—

As the absolute temperature of receiving heat
is to the difference between the absolute temperatures of receiving and discharging heat,
so is the whole heat received
to the portion of heat permanently converted into mechanical power;

that is to say,

so is unity to the efficiency of the engine.

* The product of the volume in cubic feet of one pound of atmospheric air, by its pressure in pounds on the square foot, at the temperature of melting ice, is 26,214 foot-pounds. The corresponding product, at any other temperature, is found with a degree of accuracy sufficient for practical purposes, by multiplying the absolute temperature by $\frac{26,214}{493}$=53·172 foot-pounds per degree of Fahrenheit. In the detailed investigations already referred to, the absolute zeros of heat and of pressure have had various positions assigned to them as the most probable, within a range of about 4° Fahrenheit, according to the degree of precision of the experimental data, existing at the periods when the several papers were written. This range of variation, however, is not sufficient to cause any error of practical importance in calculations respecting engines.

This proportion may be otherwise expressed, as follows :—

As the absolute temperature of receiving heat
is to the absolute temperature of discharging heat,
so is the whole heat received
*to the necessary loss of heat.**

To illustrate the above law, the following table is added, showing four examples of the efficiencies of theoretically perfect engines working between limits of temperature, to which there will be occasion to refer in the sequel: the 7th column shows, in each case, the maximum theoretical duty of a pound of coal, supposing, as before, that the whole available heat of its combustion is equivalent to 6,000,000 foot-pounds: the 8th column shows, for each example, the corresponding minimum theoretical consumption of coal per horse-power per hour: the limits of temperature chosen in the five examples are respectively as follows :—

(1.) The limits of temperature for a condensing steam engine, with a pressure of 42 lbs. per square inch in the boiler, and 2·9 lbs. per square inch in the condenser: (in every instance in this paper in which a pressure is mentioned, it is to be understood to mean the *total pressure*, and not the *excess* above the pressure of the atmosphere.)

(2.) The limits of temperature for a non-condensing steam engine with a pressure of 153 lbs. per square inch in the boiler.

(3.) A probable estimate of the limits of temperature of Ericsson's air engine of 1852.

(4.) The same for Stirling's air engine, and also for that of Napier and Rankine.

The actual efficiency of these engines will be considered in another part of this paper.

Examples of Maximum Theoretical Efficiency.

Nos of Examples.	Temperatures in Degrees of Fahrenheit.				Maximum theoretical Efficiencies.	Maximum theoretical Duties of one pound of Coal,	Minimum theoretical Consumption of Coal per horse-power per hour,
	Ordinary.		Absolute.				
	Higher.	Lower.	Higher.	Lower.		ft.-lb.	lb.
1	270	140	731	601	$\frac{130}{731}=0{\cdot}178$	1,067,000	1·86
2	360	212	821	673	$\frac{148}{821}=0{\cdot}180$	1,080,000	1·83
3	480	100	941	561	$\frac{380}{941}=0{\cdot}404$	2,424,000	0·82
4	650	150	1111	611	$\frac{500}{1111}=0{\cdot}450$	2,700,000	0·73

In order to show the manner in which the pressure and volume of elastic substances vary, in producing the maximum theoretical efficiency of

* There are other forms in which this law might be expressed; but those stated above are the most readily applicable to the performance of engines worked by heat, and are therefore to be preferred in a paper such as the present. See Trans. Royal Soc. Edin., Vol. xx. (1850 to 1853,) and Phil. Trans., 1854.

Carnôt was the first to perceive, that the maximum effect of the expenditure of a given quantity of heat in a thermo-dynamic engine must be a function of the temperatures of receiving and discharging heat: but the hypothesis of the substantiality of heat misled him as to the nature of the function.

a thermo-dynamic engine, so as to verify in every case the general law, a supplement is added to this section, containing detailed computations for three examples of theoretically perfect engines: viz., a steam engine working between 270° and 140°, an air engine working between the same temperatures, and an air engine working between 650° and 150°.

11. As the law above stated is true for all substances whatsoever in all conditions, it is obvious that, in a purely theoretical point of view, the only reason for preferring any one substance to another, as the agent in converting heat into mechanical power, is the greater ease and safety of causing it to expand by heat at a high temperature. In this point of view, permanent gases are preferable to vapors rising from liquids; for the density of a permanent gas can be regulated at pleasure so as to limit its pressure at any temperature, how elevated soever, to a safe and manageable amount; whereas, a given vapor, while in contact with its liquid, has but one possible density for each given temperature, and consequently but one possible pressure; and as the pressures of the vapors of all easily obtainable fluids increase very rapidly with the temperature, it would be unsafe to use vapors at temperatures at which it is safe and easy to use permanent gases. For example, at the temperature of 650° Fahr. (measured from the ordinary zero,) a temperature up to which air engines have actually been worked with ease and safety, the pressure of steam is 2100 pounds upon the square inch; a pressure which plainly renders it impracticable to work steam engines with safety at that temperature.

SUPPLEMENT TO SECTION I.—A. *Example of the computation of the power produced by the combustion of one pound of coal in a theoretically perfect Steam Engine, working between the temperatures of* 270° *and* 140° *of Fahrenheit.*

Data.—Mechanical equivalent of the whole available heat obtained by the combustion of 1 lb. of coal, 6,000,000 ft.-lb.

	In Boiler.	In Condenser.
Temperatures (ordinary scale),	270° Fahr.	140°
Absolute Temperatures,	731 "	601
Pressures,	lb.	lb.
Per square inch,	41·93	2·89
" foot,	6038·	415·7·
		Cubic feet.
Volume of one pound of steam in the boiler,		9·852
		ft.-lb.
Latent heat of evaporation of one pound of steam (mechanical equivalent),		715,800

Computation of the maximum theoretical duty of one pound of coal by the general law.

Theoretical maximum efficiency, $\frac{270°-140°}{731°}\quad\frac{130°}{731°}=0·178$

Duty of one pound of Coal, $\frac{130}{731}\times 6{,}000{,}000 = 1{,}067{,}000$, as in Example I. of the table in article 10.

Computation of the maximum theoretical duty of one pound of coal, introducing the changes of pressure and volume undergone by the Steam.

Water evaporated by one lb. of coal,

$$= \frac{\text{available heat of combustion}}{\text{latent heat of one lb. of steam}} = \frac{6{,}000{,}000}{715{,}800} = 8{\cdot}382 \text{ lbs.}$$

Ratio of expansion required to enable the steam to produce its maximum effect, 10·774.

The detailed computation of this ratio is too tedious to be inserted here. The method pursued is fully explained in the Philosophical Transactions for 1854, Part I.

	Per lb. of water. Cubic feet.	Per lb. of coal. Cubic feet.
Space filled by steam at full pressure,	9·852	82.579
at the end of the expansion, . .	106·04	888·82

= space traversed by the piston.

Effect of one pound of steam, $715{,}800^{\text{ft.-lb.}} \times \frac{130}{731} = 127{,}297^{\text{ft.-lb.}}$.*

Effect of one pound of coal, $127{,}297 \times 8{\cdot}382 = 1{,}065{,}008^{\text{ft.-lb.}}$ as before.

Mean effective pressure during the whole action of the steam,

$$= \frac{\text{effect}}{\text{space}} = \frac{127{,}297}{106{\cdot}04} = \frac{1{,}067{,}000}{888{\cdot}82} = 1200{\cdot}46 \text{ lbs. per square foot} = 8{\cdot}34 \text{ lbs. per square inch.}$$

Coal per horse-power per hour.

$$\frac{1{,}980{,}000}{1{,}067{,}000} = 1{\cdot}86 \text{ lbs., as in the 1st Example of the table in Article 10.}$$

B. *Example of the computation of the power produced by the combustion of one pound of coal in a theoretically perfect Air Engine, working between the temperatures of* 270° *and* 140° *of Fahrenheit.*

(The object of the following computation is not to exemplify the mode of working of any existing or proposed air engine, but simply to illustrate the fact, that the maximum theoretical efficiency of thermo-dynamic engines is the same when the limits of temperature are the same, of what nature soever the working substance may be.

It is also to be observed, that the *maximum theoretical duty* of one pound of coal in an air engine is independent of the rate of expansion of the air, and of its density and pressure. The rate of expansion affects the weight of air which must be employed to perform a given duty, and the densities and pressures affect the size of the receivers and cylinders required to contain that weight of air.

If definite values, therefore, are assumed for those quantities in the following calculations, it is only for the sake of fixing the ideas, and giving numbers instead of algebraical symbols.)

Data.—Mechanical equivalent of the whole available heat obtained by the combustion of one pound of coal (as before) 6,000,000 foot-pounds.

Ratio of expansion of air, . . . $1 : 1\frac{1}{2}$

* This quantity consists of the total action of the entering and expanding steam, on one side of the piston, diminished by the action of the steam which is being condensed on the other side, and also by the power consumed in producing, by the forcible compression of part of the steam into the liquid state, a quantity of heat sufficient to raise the temperature of the water from 140° to 270° Fahrenheit.

The air is alternately expanded and compressed in this ratio.

	During Expansion.	During Compression.
Temperatures (ordinary scale), .	270° Fahr.	140°
Absolute temperatures, .	731 "	601

Product of the volume of one pound of air in cubic feet by its pressure in pounds on the square foot at 32° Fahr., 26,214 ft.-lbs.

Computation of the maximum theoretical duty of one pound of coal by the General Law.

Theoretical maximum efficiency, $\frac{270°-140°}{731} = \frac{130}{731} = 0{\cdot}178.$

Duty of one pound of coal, $\frac{130}{731} \times 6{,}000{,}000$ ft.-lbs. $= 1{,}067{,}008$ ft.-lbs., as in Example I. of the table in Article 10.

Computation of the maximum theoretical duty of one pound of coal, introducing the changes of pressure and volume of the Air.

Product of the pressure and volume of one pound of air at the temperature of 270°, $26{,}214 \times \frac{270+461}{32+461} = 26{,}214 \times \frac{731}{493} = 38{,}869$ ft.-lbs.

Power developed by one pound of air during its expansion at 270° Fahr. to one and a half times its original volume, being also the mechanical equivalent of the heat expended to produce that expansion.

$$38{,}869 \times (\text{hyp. log. } 1\tfrac{1}{2} = 0{\cdot}4054652) = 15{,}760 \text{ ft.-lbs.}$$

Weight of air which is expanded to one and a half times its volume at 270° Fahr. by the combustion of one pound of coal,

$$\frac{6{,}000{,}000}{15{,}760} = 380{\cdot}705 \text{ lbs.}$$

Pressures and volumes of the air at different periods, supposing the greatest pressure to be 120 lbs. per square inch.

	Pressures.		Volumes.	
	lbs. per sq. inch.	lbs. per. sq. foot.	cubic feet per lb. air.	cubic feet per lb. coal.
At the beginning of the expansion,	120	17,280	2·2494	856·358
At the end of the expansion, .	80	11,520	3·3741	1284·537
Space through which the air expands, = space traversed by the piston. . .			1·1247	428·179

	Mean Pressures.		Power = Mean Pressure × Space.	
	lbs. per sq. inch.	lbs. per. sq. feet.	in foot-pounds. per lb. air.	per lb. coal.
Mean pressure and power during the expansion,	97.3	14012·88	15,760	6,000,000
Deduct mean pressure and power during the compression, $= \frac{601}{731}$ of the above, . .	80·0	11520·85	12,957	4,933,000
Effective mean pressure and power, $\frac{130}{731}$.	17·3	2492·03	2,803	1,067,000

The calculations A and B illustrate the fact, that the maximum theoretical effect of one pound of coal between a given pair of temperatures is the same, whether the working substance be air or steam.

C. *Example of the computation of the power produced by the combustion of one pound of coal in a theoretically perfect Air Engine, working between the temperatures of* 650° *and* 150° *of Fahrenheit.*

Data.—Mechanical equivalent of the whole available heat obtained by the combustion of one pound of coal (as before), 6,000,000 foot-pounds.

Ratio of expansion of air, $1 : 1\frac{1}{2}$.

	During Expansion.	During Compression.
Temperatures (ordinary scale), . .	650° Fahr.	150°
Absolute temperatures, . . .	1111 "	611

Product of the volume of one pound of air in cubic feet by its pressure in pounds per square foot at 32° Fahr., 26,214 foot-pounds.

Computation of the maximum theoretical duty of one pound of coal by the General Law.

$$\text{Maximum theoretical efficiency, } \frac{650-150}{1111} = \frac{500}{1111} = 0{\cdot}45.$$

$$\text{Duty of one pound of coal, } \frac{500}{1111} \times 6{,}000{,}000 = 2{,}700{,}000 \text{ ft.-lbs.,}$$

as in Example IV. of the table in Article 10.

Computation of the maximum theoretical duty of one pound of coal, introducing the changes of pressure and volume of the air.

Product of the pressure and volume of one pound of air at the temperature of 650°.

$$26{,}214 \times \frac{650+461}{32+461} = 26{,}214 \times \frac{1111}{493} = 59{,}074 \text{ ft.-lbs.}$$

Power developed by one pound of air during its expansion at 650° Fahr., to $1\frac{1}{2}$ times its original volume, being also the mechanical equivalent of the heat expended to produce the expansion.

$$59{,}074 \times (\text{hyp. log. } 1\tfrac{1}{2} = 0{\cdot}4054652) = 23{,}953 \text{ ft.-lbs.}$$

Weight of air which is expanded to $1\frac{1}{2}$ times its volume at 650° Fahr. by the combustion of one pound of coal.

$$\frac{6{,}000{,}000}{23{,}953} = 250{\cdot}5 \text{ lbs.}$$

Pressures and volumes of the air at different periods, supposing the greatest pressure to be 120 lbs. per square inch.

	Pressures.		Volumes.	
	lbs. per sq. inch.	lbs. per sq. foot.	cubic feet per lb. air.	cubic feet per lb. coal.
At the beginning of the expansion,	120	17,280	3·4186	856·358
At the end of the expansion, .	80	11,520	5·1279	1284·537
Space through which the air expands, ... = space traversed by the piston.			1·7093	428·179

	Mean Pressures.		Power = Mean Pressure × Space.	
	lb. per sq. inch.	lb. per sq. foot.	in foot-pounds per lb. air.	per lb. coal.
Mean pressure and power during the expansion,	97·3	14012·88	23,953	6,000,000
Deduct mean pressure and power during the compression $= \frac{611}{1111}$ of the above,	53.5	7707·09	13,173	3,300,000
Effective mean pressure and power, $\frac{500}{1111}$	43·8	6305·79	10,780	2,700,000

Theoretical minimum consumption of coal per horse-power per hour.

$$\frac{1,980,000}{2,700,000} = 0{\cdot}73 \text{ lbs.}$$

as in Example IV. of the table in Article 10.

Synoptical Table of the preceding Examples.

Reference.	Working substance.	Temperatures.		Effective mean pressure, lbs. per square ft.	Spaces	Effects
		Ordinary Fahr.	Absolute Fahr.		Per lb. of coal.	
		°	°		Cubic ft.	Foot lbs.
A	Steam (maximum pressure 41·93 lbs. per square inch = 6038 per square foot).	270 & 140	731 & 601	1200·46	888·82	1067000
B	Air (maximum pressure 120 lbs. per inch = 17,280 per square foot.)	270 & 140	731 & 601	2492·03	428·179	1067000
C	Air (maximum pressure same as above).	650 & 150	1111 & 611	6305·79	428·179	2700000

A detailed mathematical investigation of the theory of air engines, with and without regenerators, is contained in the third and fourth sections of a paper on Thermo-Dynamics in the Philosophical Transactions for 1854, Part I., together with some numerical illustrations.

Theoretical investigations of the duty of air engines of different forms are contained in a paper by Mr. Joule (Phil. Trans., 1851,) and in a series of papers in the *American Journal of Science* for 1853 and 1854, by Professor F. A. P. Barnard, the first American author, so far as I know, who has aided in the development of the consequences of the dynamical theory of heat.

(To be Continued.)

*On "Driers" and the Improvement of House-Painters' Work.**

We are sure it is not necessary to give further reasons for presenting the details which it has cost us some trouble to extract from the elaborate tabular statements of M. Chevreul. We will not attempt to point out the application of the result of each series of experiments; but they deserve every consideration from all who, like ourselves, are interested in the progress of constructive science and the advancement of art. If they do not specify in words, what must be done for the objects *we* have contemplated, they are the necessary basis without which such progress could not be hoped for; and the remaining chapters present particulars equally important to architects and decorative painters, as also to those engaged in the preparation of materials.

We have already, we trust, established safe ground as to the nature of that which is called the drying of the work—under several modifications of the vehicle or pigment used, and the character of the material and surface. We found that the ordinary carbonate of lead base and the pure linseed oil each possessed siccative properties, and that in the case of the oil, these might be increased by time and exposure to the air, supposing it were convenient to resort to such means.

We have received testimony from practical painters to the soundness of the opinion upon which we ventured, as to the constant antagonistic influence of "driers," as regards the chief objects of painting. There is no doubt that much of the want of durability is to be traced to ignorance of such points as we are inquiring into,—or to exclusive regard for early completion of work. It has, however, been apparent, that, considering the time which can generally be allotted, some proportion of "drier" is not to be dispensed with. In particular, we found, that were it the object to escape from deleterious influences entailed by the use of white of lead, by resorting to the white of zinc,—that material had the siccative property in so comparatively slight a degree, as would positively prevent trial of any of its recognised advantages. It, therefore, becomes of some importance to know what is the best mode of preparing "driers."

We shall follow M. Chevreul in his researches, leaving open the question between white of lead and white of zinc; though were we now to accept the latter base of pigments, experiments as to the *ordinary* "drier" might be thought superfluous. We therefore proceed to inquire into the influence of litharge, of peroxide of manganese, and of the mere application of heat, in rendering linseed oil siccative. It is necessary to consider the latter influence, apart from that of the metallic oxide, to ascertain whether the heat is ordinarily applied in the best manner.

The common "drier," or litharged oil, in France, is generally made thus:—Linseed oil is heated to near the boiling point in a melting pot, and skimmed: after three or six hours, about one-tenth of its weight of litharge is added to the oil, and the mixture is again heated for five or six hours. Another method is the following:—100 kilogrammes of linseed oil, as old as possible, are heated for about six hours; six kilogrammes of litharge, and three kilogrammes of burnt umber are then added;

* From the Lond. Builder, No. 650.

the mixture is heated for six hours, is allowed to settle, and is decanted. The litharged oil, M. Chevreul says, is adulterated with substances which are greatly injurious to its properties. This remark may apply to the sulphate of zinc spoken of by Dr. Thompson, as required to be added to the litharge. The ordinary English method would seem to correspond with that used in France. M. Leclaire, to whom the chief credit of the introduction of oxide of zinc is due, prepares his manganesed oil thus:—Linseed oil is heated at the boiling point for five hours; then for eight hours at least, with peroxide of manganese.—It will now be discovered which are the best methods of procedure.

Experiments were made in the first four months of the year 1850, with the several oils, laid as before, on oak; and we have again tried to condense M. Chevreul's extended statements in a new table. The different kinds of oil experimented upon, are written at the heads of the columns; and the letters of reference (which correspond with those used by M. Chevreul) refer to the notes and particulars below:—

Reference to Notes:—	A	EE	E	B	CC	C	D	F	FF
Oil, how prepared:—	Linseed Oil, pure.	Linseed Oil; boiled 3 hours.	Linseed Oil; boiled 3 hours with 1-10 of its weight of Litharge.	Linseed Oil; boiled 5 hours over a gentle fire in a melting-pot.	Linseed Oil B; again boiled 3 hours (without addition.)	Linseed Oil B; boiled 3 hours with 1-10th of its weight of Litharge.	Linseed oil B; boiled 3 hours with Peroxide of Manganese which had been used previously.	Linseed Oil B; boiled 8 hours with Peroxide of Manganese which had been used previously.	Linseed Oil B; boiled 8 hours (without addition.)
Days occupied in Drying:—									
First coat, ...	99	41	2	54	40	4	5	16	54
Second coat, ...	6	4	3	6	4	5	6	10	
Third coat, ...	3	4	2	8	6	6	6	13	
Total,—Days, . . .	108	49	7	68	50	15	17	39	

Notes and Conclusions from the foregoing Table.

References.

A. EE.—The oil by 3 hours boiling, becomes more siccative.

E. EE.—The oil by 3 hours boiling with 1-10th its weight of litharge, becomes more siccative than if boiled without the litharge.

B. EE.—Five hours' boiling not so advantageous as 3 hours.

CC. C. E.—Oil which has already boiled 5 hours without addition, again boiled 3 hours, undergoes scarcely any change in the siccative property, whilst it becomes more siccative if it has boiled the same time upon litharge: but it is less siccative than the oil which has boiled 3 hours with that oxide without the previous boiling.

D. F.—Oil already boiled 5 hours, boiled 3 hours upon peroxide of manganese that had served previously for a similar operation, is nearly as siccative as the oil which has boiled in the litharge under the like circumstances (C.)—but it is more siccative than if the boiling on the peroxide of manganese had lasted 8 hours.

FF.—Oil which has boiled 5 hours, boiled alone 8 hours more, becomes viscid, and exacts a considerable time for drying.

Generally, these experiments established the fact that the presence of the oxide of lead, or oxide of manganese, will concur with heat in augmenting the siccative property of the oil. But it also appeared from them, that the direct ebullition of the oil with the litharge during three hours only, gave more of the siccative property than the oil would have acquired by the ordinary process,—that is to say, by a previous boiling of three to six hours, or *before* treatment with the litharge. Further experiments were therefore gone into, with regard to that matter. It then appeared:—

1. That linseed oil, which has been boiled in a glass globe in a sand-bath merely, five hours, is not more siccative than the ordinary oil.

2. That the oil which has been boiled three hours, with 15 per cent. of its weight of litharge, or of peroxide of manganese, is more siccative than the oil which has been heated five hours.—At the same time we arrive at these important facts:—

(*a*) That litharge is more siccative than peroxide of manganese.

(*b*) That litharge that has been once heated with the oil, if used for a further portion of oil, is positively more active than that which had not been previously heated.

(*c*) That peroxide of manganese which has been heated many times, has similar effects, relatively to manganese, which had not been heated.

It also appears that—

3. The oil which has undergone a heating of five hours, heated again with 15 per cent. of its weight of litharge, is more siccative than if it had been heated with peroxide of manganese.

But it is remarkable that the *excess* of activity distinguishing the litharge, and the peroxide of manganese which have been used previouly in heated linseed oil, from the same ingredients in their first condition, and where linseed oil was in its original condition, exists no longer where *oil* has undergone the heating process during five hours.

Having discovered that the usual length of time occupied in heating —or rather stewing—in the preparation of "driers," was not advantageous, M. Chevreul proceeded with experiments by which was discovered the fact, that the oil exposed for six hours to a temperature of, as nearly as possible, 70 degrees, with 10 per cent. of peroxide of manganese, could be employed immediately in painting, without the necessity of adding a (or we think it should rather have been stated, *any other*) siccative. Pure oil exposed the same time to the like temperature, receives also a considerable increase of the siccative property, but not to the extent discovered in the other case. The special value of the particular combination referred to is shown by results supposed to be as under. Experiments were commenced at the end of January, 1850, the coats being laid on glass. Pure linseed oil is first contrasted with the manganesed oil: thus—

	Linseed oil.
First coat required to dry, .	21 days.
Second " " " .	10 "
Third " " " .	7 "
Total, .	38 days.

The other result being here stated:—

	Linseed oil, heated six hours, at from 70 to 80 degrees, with 10 per cent. of peroxide of manganese, which had been used previously several times.
First coat required to dry, . . .	3 days.
Second " " " . . .	3 "
Third " " " . . .	3 "
Total, . . .	9 days.

An addition of white of zinc to the oil last mentioned, appears to give an increase of siccative property, much exceeding what it would give to the pure oil.

This branch of the subject may be wound up with the results of a comparison of oils differently treated, as under. The experiments were commenced at Midsummer, 1850, the coats being laid on glass. The oils were (using letters of reference for the columns of the table):

(A.) Pure linseed oil.
(B.) The same oil, exposed six hours to a temperature of 70 to 80 degrees.
(C.) The same oil, heated during six hours at a temperature near to the boiling point, with new peroxide of manganese.
(D.) The same oil, heated in the same manner with peroxide, which had been used twice.

Days occupied in drying.	A.	B.	C.	D.
First coat, . .	6	4	2	0½
Second " . .	6	5	4	4
Third " . .	5	5	4	2
Total: Days,	17	14	10	6½

The short period occupied in the drying of the first coat in the fourth column is remarkable. In some previous experiments, similar unexpected results occur where coats were laid on wood. Those cases suggested to us inquiry whether sufficient absorption could have taken place to ensure durability. It is, however, due to M. Chevreul to say that this question was not wholly neglected, for independent of the record given of the exact state of the surface on every day during the progress of the experiments (our own pages having limited us to results,) in experiments tried on certain materials, the paint is specially mentioned as of slight adherence to the wood. These instances are chiefly in the concluding chapter.

Various additions have been made to the pure substances, carbonate of lead and oxide of zinc, not only in the course of extensive adulteration which is practised, but in other cases, with the idea of particular beneficial results. It may therefore be interesting to follow our author where he endeavors to find what is the sort of influence which certain bodies, mixed with one or other of the above mentioned bases, will exercise as regards the general drying properties. He finds that sulphate of lead mixed with linseed oil is much less siccative than the carbonate,—the three coats—if laid on oak in summer—occupying nearly three times as long in the drying as three coats, similarly laid, of the carbonate. However, whilst the bulk of the excess of time was occupied by the first coat, the second coat of the sulphate dried in precisely the same number of days as that of the carbonate. A *mixture* of the sulphate and the carbonate appears to have been introduced in France about 1850. That material, M. Chevreul found would dry as well as the pure carbonate; in other words, the sulphate had received from the carbonate a consider-

able accession in siccative properties. But it is observed that the mixed material had some tendency to work unevenly under the brush.

Passing to the zinc base,—the *sub-carbonate* of zinc has been tried. It begins to dry more quickly than the oxide, and might therefore be supposed to afford advantages, if mixed with the latter. It has, however, the disadvantage of being "semi-transparent," and is altogether very different to the white of lead, or even to the white of zinc. Still, M. Chevreul thought advantage might be taken of the peculiar siccative property, as a substitute for the oil of manganese, which has the inconvenience of interfering with that peculiarity of the oxide of zinc, for which, at all events, it is valuable, namely, its peculiar whiteness. Experiments were commenced, therefore, on two deal doors, and in Midsummer, 1849, with the mixtures designated below, A and B:—

		Parts by weight.
(A.)	Pure linseed oil, . .	100
	White of zinc (oxide) 0¾ by measure, Sub-carbonate of zinc, 0¼ by measure,	100
(B.)	Pure linseed oil, . . .	98
	Manganesed oil, . .	2
	White of zinc (oxide,) . .	100

The first coat applied of each, had an equality of aptitude as regards the covering of the surface; and four hours after application the paint had taken hold. The mixture A, however, showed a disposition to dry best where most exposed to the light. On comparison at the end of a year, the door painted with A was sensibly more white than the other. Perhaps, however, the paint was less adherent than the mixture B. Yet M. Chevreul does not seem to consider the difference of much moment, since he goes at once to the advantages of the admixture,—saying, that whilst there can be no material difference as to the drying in A and B, the former has advantages with white grounds, or such light tints as yellow would be injurious to.

The effect of finely-divided powders upon the drying of a vehicle, is, M. Chevreul remarks, that of accelerating the drying,—as might be expected, apart from chemical influences.

In the course of our examination into the series of experiments, we have attached, certainly, great importance to the absorption of the coating by the material painted. No artist, we are sure, will differ with us for having gone greatly beyond M. Chevreul, in desiring with the durability of substance and surface, the absence as a general rule, of all shining appearance. No doubt the brilliant and the "dead" character of surface can be used side by side, and might be so more frequently than they are, with the best effect. Nevertheless, there is good esthetic reason for the practice of finishing the best kind of work in flatted color. Wherever there is "surface enrichment," in form or color, or where there is moulded ornament, a general shining varnish seems to be only antagonistic to the effort of the design. Such a surface by reflecting, is necessarily unequal and accidental in its effect, and calculated to annihilate defined form. Herein, lies a disadvantage of pictures painted in oil, as compared with those in fresco,—a disadvantage which was well under-

stood a few years since, when the subject was under discussion, but which latterly seems not to have received much consideration.

We allude again to this element in our subject of investigation, because the experiments which are the last mentioned in M. Chevreul's paper, appear to be not unconnected with the end to which the discoveries of chemistry will, we hope, one day reach. On this point we hope to offer some suggestions.

For the Journal of the Franklin Institute.

Storm's Cloud Engine.—Correction of Error.

To the Committee on Publications.

GENTLEMEN—My attention has been called to an article upon "Storm's Cloud Engine" in the August number of your Journal, in which a statement is made, that in justice to myself and others should be corrected.

I refer to that portion of the editorial remarks which states that "the experiments, alluded to in the concluding paragraph, were conducted, we believe, under the superintendence of Charles W. Copeland." This is an error.

No experiments producing such results as those stated were conducted by me. Experiments had been made by others, in which some such amount of gain (about 60 or 80 per cent.) was reported.—It *is* true that I have been conducting a series of experiments, but the results have not yet been reported on to the Company, (except verbally;) in fact, the whole series has not yet been completed. Preparations are now being made for that purpose.

CHARLES W. COPELAND.

For the Journal of the Franklin Institute.

Consumption of Fuel by the Steamer Ericsson in a Voyage from Havre to New York.

We publish the following memoranda of the consumption of fuel by the steamer *Ericsson*, in a late voyage from Havre to New York. The weather for the greater part of the trip was very unfavorable, the wind being ahead and the sea very rough, and the wheel of the steamer was so defective as to give but little increase of speed when the number of revolutions was increased from 10 to 15 per minute; yet we consider the economy of fuel so remarkable as to deserve a permanent record. They are copied from the daily official reports of the Engineer.

The *Ericsson* is 260 feet long and 40 in maximum breadth; draft loaded, 18 feet. Tonnage, 2003. The engine consists of 2 inclined cylinders, 62 inches diameter, 7 feet 10 inches stroke. The boilers are of an oval form, $17 \times 14 \times 10$ feet. The condensers are on a plan patented by Captain Ericsson, and furnish hot fresh water to the boilers. The wheels are 32 feet in diameter, 10 feet on the face and dip when the vessel is loaded 5 feet.

The following table is an extract from her log:

Date.	Revolutions.	Coal used in tons.	Pressure.	Vacuum.	Cut-off.	Distance run in nautical miles.	Temperature of fire room.	
1855.		T. Cwt.			Feet.			
Aug. 5,	5,532		33·	27·	3·		76	Broke valve of air-pump.
" 6,	12,768		33·	26·5	3·	207	90	
" 7,	15,196	12 16	34·5	26·	3·	195	88	
" 8,	11,947	11 10	31·	25·5	3·	87	83	
" 9,	13,571	18	32·	26·	3·	185	90	
" 10,	15,226	18 13	31·	26·5	2·9	153	. .	Winds ahead and heavy
" 11,	14,302	19 02	31·	26·	2·9	153	84	—sea very rough.
" 12,	17,598	20	32·	26·	2·9	204	84	
" 13,	14,277	18 08	30·	26·	2·9	161	80	
" 14,	15,111	19	33·	26·5	2·9	170	78	
" 15,	15,495	18 08	35·	26·	2·6	144	90	
" 16,	16,885	18 13	31·	26·5	2·6	185	86	
" 17,	21,253	20	35·	26·5	2·9	237	90	
" 18,	19,968	20	33·	26·5	2·6	205	96	
" 19,	20,753	21 13	35·	26·5	2·6	222	94	
" 20,	21,211	20 07	34·	28·	2·3	233	96	Wind light—sea calm.
" 21,	21,691	21 10	35·	25·5	2·3	245	96	

The average consumption is 18·533 tons per day.

" " speed 186·6 nautical miles per day.

The fuel burned was partly Welsh and Pennsylvania Anthracite, and, for a short time, Cumberland coal.

In the last three days, with Pennsylvania Anthracite as fuel, the average consumption was 20·76 tons per day; the distance run, 233 nautical miles per day, or 9·5 per hour. J. F. F.

For the Journal of the Franklin Institute.

English Novelties.

New Form of Safety Valve.—We notice in the *London Practical Mechanics' Journal*, a description of a new form of safety valve, lately brought out by W. Hawthorne, Newcastle-on-Tyne. It is designed to apply to the objection against the conical valve ordinarily used, that when lifted by hand, or by a pressure of steam but slightly above that to which it is loaded, only a small passage is afforded the steam between the valve and seat; so that in order to insure the requisite area for the exit of all the steam generated in a boiler, it is necessary to employ a valve whose area is far greater.

Mr. Hawthorne proposed the use of what are called annular safety valves, and drawings are given of two or three plans in which the principle is carried out, of affording large area, the moment the valve is raised from its seat.

In the first of these, the seat is flat and perforated with narrow open-

ings; the valve is likewise flat and is also similarly perforated, the concentric openings falling between those in the seat, and at such distances, that when the valve is seated, the requisite lap is given, to insure tightness. Radial ribs hold the parts of the valve together and to a central sunken boss, on the bottom of which bears the point of the stud connected at its upper end with the lever and weight, or with the spring pressing it down, as the case may be.

It is obvious that the moment the valve lifts, free opening is afforded.

In the second plan an annular opening is left in the seat turned conically on each edge, into which is fitted a ring (bevelled), which ring is connected by radial ribs to the central bearing boss. By raising a valve so made, opening is afforded both inside and outside the ring, and of course the width of the annular opening by its mean circumference will give the required area, and the narrower the ring, the greater in proportion will be the circumferential opening.

The third plan proposed is the Cornish double beat or equilibrium valve.

The idea thus proposed may not be entirely novel, but it appears to us to be a good one and worth trial. There are few parts of steam machinery to which engineers more tenaciously hold than the old-fashioned safety valve, while we know of none more defective, or in which it is so vitally important to introduce every possible improvement.

Pump Stuffing Boxes.—Mr. H. Teague, in an article contained in the *Journal*, previously quoted, recommends the introduction of a species of hollow lantern brass in the middle of the depth of pump stuffing boxes; opposite to this brass, in the stuffing box, a pipe is inserted, leading to the discharge pipe, so that the pump will always draw water through any leakage opening in the stuffing.

Fluid Measures.—To obviate the difficulty and expense of graduating separately by measurement each fluid glass now made, Mr. H. Hudson, of South Shields, England, has patented a process for making them by pressure, so that they will be always of precisely the same size and may be graduated by the same scale. To accomplish this end, the mould is made either solid or in parts as may be required by the configuration of the vessel; and a plunger of the shape required for the interior is brought down into it, melted glass having previously been dropped in. By this method the inequalities incident to the hand process must be completely avoided.

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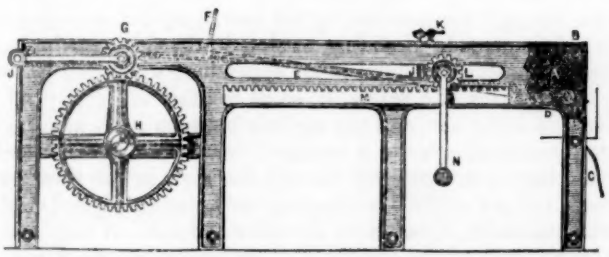
*Driving Belts.** J. Blaikie, Glasgow. Patent dated November 7, 1854.

Smoothness of action, so essential in most kinds of machinery, very much depends on the quality of the driving belts employed, and great difficulty is experienced in obtaining leather of uniform thickness for making such belts, so that any efficient means of producing belts possessing the necessary qualifications, at a comparatively cheap rate, must be considered as a great boon by the machinery-using community of manufacturers. The present invention professes to confer this boon, and merits some attention on that ground, independently of its claims as bringing

* From the Lon. Prac. Mech. Journal, August, 1855.

very simple means to the accomplishment of the desired result. The invention relates to the preparation and manufacture of belts, straps, and bands, such as are used for driving machinery and for other purposes, in such manner as to produce perfect uniformity, as well in the main body of the leather or material employed as at the junctions, where the overlapping of the ends is effected. The leather or other material to be used in the manufacture of the belt, or band, is first passed through a machine for the purpose of equalizing its thickness, by shaving or slicing off the superfluous material wherever such superfluity may exist. This machine consists of a rectangular frame, having at one end a roller or gauge-piece capable of being set up at a greater or less distance from a stationary cutter or knife. The band to be treated is entered by one end between the cutter or knife and the roller or gauge-piece, and it is then forcibly drawn through between these contiguous surfaces, by a pulley or other suitable action. This treatment causes the cutter or knife to slice off all the superfluous material, and bring the band down to the requisite thickness and uniformity. After this process, the band or piece of leather is passed through a somewhat similar machine, or through the same machine suitably arranged, for the purpose of beveling the junction ends of the leather. To accomplish this action, the thicknessing roller or gauge-piece, which is set parallel with the knife, is carried upon the ends of the shorter arms of two curved or inclined levers set on fixed studs in the machine framing. The band is then drawn through as before between the cutter and its gauge-piece or roller, this tractive action being conveniently effected, by a rack and pinion movement driving the holding clamp for the end of the band. This traversing holder carries adjustable stud-pins, made to bear on the upper sides of the longer arms of the lever, or levers, with which the cutter roller or gauge-piece is connected. Hence, as the traverse goes on, and the leather is drawn through the adjustable studs upon the traverse, details bear down upon the sha-



ping levers, and cause the roller or gauge-piece to gradually approach the cutting edge, and thus cause the cutter to make an inclined or beveled slice. The beveled ends of such bands may be joined together for use, either by cement or stitching, or in any other convenient manner. Bands or belts made in this way are perfectly uniform in thickness, and they are for this reason far more effective in action than bands of the common kind.

Our engraving is a side elevation of the improved machine for equal-

izing the thickness of belts for machinery. The details of the machine are carried in a framing consisting of a pair of parallel cast iron side standards, connected together by tension rods. The knife, A, by means of which the belt is reduced to the required uniform thickness, is situated close to the end, B, of the frame, and it is fixed by having its two ends entered into slots in the side standards, being accurately adjusted by means of external pinching screws. The edge of the knife is towards the end, B, of the machine, and the belt, C, to be operated upon passes under it, and between it and a roller carried in eyes in the ends of two short levers fast on a transversed spindle, D, turning in eyes in the side standards; and this spindle has also formed or fixed upon it a long lever, E, which has a graduated segment, F, formed on its outer end. By raising or lowering the lever, F, the guide roller is made to recede from or approach the cutting edge of the knife, A, and by so doing the thickness to which the belt is to be reduced is accurately determined, the graduated segment, F, serving as an index, by which the position of the roller is regulated. The belt, C, is stretched upon the surface of the roller, so as to be presented to the knife edge in a uniform tight manner, by means of a bar capable of adjustment to suit the thickness of the belt under treatment. After passing under the knife, A, the belt, C, passes on over the driving-spindle at G, and thence to the winding-up barrel at H. The spindle of this barrel has keyed upon it a spur-wheel in gear with a pinion fast on the spindle, G, upon which is also fixed a winch-handle, I. By turning this handle, the barrel, H, is made to wind up the belt, C, and so draws it through between the roller and the knife, A, and by these means the belt is reduced to a uniform thickness, the knife taking off all the material of the belt which exceeds the thickness for which the apparatus is set.

Arrangements are provided in the same machine for beveling or tapering the junction ends of the belt. This beveling is effected by causing the guide-roller to gradually approach the knife, A, as the belt is drawn through the machine. When the end of the belt is to be beveled, it is not drawn through the machine by the barrel, H, but is held between a bar, J, which is capable of sliding in slots in the side standards, and an adjustable clamp-piece, linked to an upper bar, which is adjusted upon the bar, J, by means of a screw, K, so as to draw the clamp up against the under side of the bar, and nip the belt between itself and the bar. A transverse horizontal spindle is arranged to work in eyes formed on the ends of the bar, J, and passing through the slots in the side standards, has pinions, L, fixed on its overhanging ends, these pinions being in gear with horizontal racks, M, bolted to the side standards. A winch-handle, N, is fixed on one end of the spindle, and by turning it, the bar, J, will be made to traverse along the slots, in consequence of the action of the pinions, L, on the racks, M. At the part of the bar, J, which is immediately over the lever, E, is a screw-pin, which, as the bar, J, traverses away from the end, B, of the machine, gradually depresses the lever, E. By these means, as the end of the belt is being drawn between the knife, A, and the guide-roller, the latter is made to gradually approach the knife, which, consequently, cuts more and more deeply into the material, finally getting quite through it, and producing a regularly-formed bevel upon

the end of the belt. The length of the bevel or inclined portion of the belt is regulated by adjusting the screw-pin in the bar, J, so as to commence its action on the lever, E, at a point nearer to, or further from, its centre of oscillation. The length of the bevel is also determined by means of a gauge-piece, O, at the end, B, of the machine, being held in an adjustable socket-piece screwed to one of the tension bars of the frame. The gauge, O, is set at a distance from the knife edge, A, corresponding to the length of bevel to be given to the end of the belt, and the belt is introduced in such a manner that its extreme end will just reach the gauge, O, at the commencement of the beveling action.

For the Journal of the Franklin Institute.

Particulars of a New English Iron Steamer, Alma.

Hull built by Thomas B. Seth; Machinery by A. & J. Inglis, Glasgow. Intended service, coastwise.

HULL.—

Length of keel and fore rake,	115 feet.	
" on deck,	112 "	5 inches.
Depth of hold,	8 "	8 "
Length of engine and boiler space,	21 "	8 "
Draft of water at load line,	7 "	3 "
Tonnage, hull, 179; engine room, 37.		
Contents of bunkers in tons of coal, 15.		
Mast and rig, three masted schooner.		

ENGINES.—Non-condensing—Inverted cylinder.—

Diameter of cylinders,		14 inches.
Length of stroke,	1 foot	8 "
Maximum pressure of steam in pounds, 60		
" revolutions per minute, 120.		

BOILER.—One.—

Length of boiler,	10 feet	6 inches.
Breadth "	5 "	10 "
Number of furnaces, 1.		
Breadth "	5 feet.	
Length of grate bars,	11 "	
Number of tubes, brass, 103.		
Internal diameter of tubes,		2 inches.
Length of tubes,	8 feet.	
Diameter of smoke pipe,	2 "	
Height " "	16 "	
Description of coal, Bituminous.		
Draft, Natural.		
Nominal horse power, 35.		

PROPELLERS.—

Diameter of screw,	5 feet	10 inches.
Length of blades,	3 "	
Pitch of screw,	10 "	
Number of blades, 3.		

Remarks.—Frame, *shape and dimensions*, I—$3 \times 2\frac{1}{2} \times \frac{5}{16}$ inch; distance apart *at centres*, 18 inches; stem, keel, and stern posts, $3\frac{1}{2} \times 1\frac{1}{4}$ inches. Clincker built. Stows 150 tons of freight, and has accommodations for six passengers.—Has run 450 miles in 41 hours 30 minutes, consuming 6·5 tons of coal. H.

For the Journal of the Franklin Institute.

Particulars of the Steamboat Island Home.

Hull built by E. S. Whitlock; Machinery by Morgan Iron Works, New York. Intended service, Boston to Cape Cod.

HULL.—

Length on deck from fore part of stem to after part of stern post above spar deck,		193 feet.	
Breadth of beam at midship section,		29 "	
Depth of hold,		9 "	3 inches.
Draft of water at load line,		4 "	6 "
" " below pressure and revolutions,		4 "	6 "
Tonnage, custom house,	450.		
Masts and rig, none.			

ENGINE.—Vertical beam.—

Diameter of cylinder,			40 inches.
Length of stroke,		11 feet.	
Maximum pressure of steam in pounds,	40.		
Cut-off,	$\frac{1}{2}$.		
Maximum revolutions per minute,	23.		

BOILER.—One—Flued.

Length of boiler,		27 feet.	
Breadth " furnace,		11 "	6 inches.
Height " exclusive of steam drum,		10 "	6 "
" " inclusive "		20 "	6 "
Number of furnaces,	2.		
Breadth "		5 feet	1 inch.
Length of grate bars,		7 "	
Number of flues, lower tier, 10, upper tier, 5.			
Internal diameter of upper flues,			16 inches.
Length of upper flues,		19 feet	$8\frac{1}{2}$ "
Heating surface, (fire and flues,)	1358 sq. feet.		
Diameter of smoke pipe,		3 "	8 "
Height " "		30 "	
Description of coal,	Bituminous.		
Draft,	Blast.		

WATER WHEELS.—

Diameter,		28 feet.	
Length of blades,		7 "	
Depth "			24 inches.
Number "	24.		

Remarks.—Floor timbers at throats, *molded* 14 inches; *sided* 5 inches. Frames apart, at centres 24 inches. Frame strapped with diagonal double laid straps 3 by $\frac{1}{2}$ inch. C. H. H.

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*Improvements in the treatment of certain Bituminous mineral substances, and in obtaining products therefrom.** By JAMES YOUNG, of Manchester. Patent dated October 17, 1850.

This invention consists in treating bituminous coal in such manner as to obtain therefrom an oil containing parafine (which the patentee calls parafine oil), and from which oil parafine is obtained. The coals best fitted for this purpose are such as are usually called parrot coal, cannel

* From the Mechanics' Magazine, April, 1851.

coal, and gas coal, and which are much used in the manufacture of gas for the purpose of illumination, because they yield, upon distillation at a high temperature, olefiant and other highly illuminating gases in considerable quantity; and although some of the coals last described contain a large amount of earthy matters, those matters do not interfere materially with the performance of this process. To obtain parafine oil from coals, the following is the method of procedure:—The coals are to be broken into small pieces, and are then to be put into a common gas retort, to which is attached a worm pipe passing through a refrigerator, and kept at a temperature of about 55° Fahr. by a stream of cold water. The temperature of the refrigerator should not be made too low, lest the product of the distillation should congeal and stop up the pipe. The retort being closed in the usual manner, is then to be gradually heated up to a low red heat, at which it is to be kept until volatile products cease to come off. Care must be taken to keep the temperature of the retort from rising above that of a low red heat, so as to prevent as much as possible the desired products of the process being converted into permanent gas. The coke or residue may then be withdrawn from the retort, which, being allowed to cool down below a visible red heat (to prevent waste of the fresh material to be introduced), may be again charged with a quantity of coals to be treated in the like manner. The crude parafine oil distilled or driven off from the coals as a vapor, will be condensed into a liquid in passing through the cold worm-pipe, from which it will fall into a vessel which must be provided to receive it. Instead of obtaining the whole of the parafine oil by distillation, a portion of it may in some cases, if thought desirable, be run from the retort (through an opening and a pipe provided in the anterior and lower part of the retort for that purpose) after it has separated from the coal and assumed a liquid form. The patentee prefers, however, in every case to distil or drive off the whole of the parafine oil to be obtained from the coal. The production of the desired products from a charge of coals in a retort will be known to be finished by the liquid ceasing to run from the worm. The crude product of this process is an oil containing parafine, which the patentee calls parafine oil. This oil will sometimes, upon cooling to a temperature of about 40° Fahr., deposit parafine. Other arrangements of apparatus may be used for subjecting coals to the process for obtaining parafine oil therefrom, but that abovementioned is preferred as being well known and easily managed. But in order to obtain the largest quantity of crude parafine oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to apply the lowest temperature necessary to complete the operation. During the distillation or driving off, a permanent gas will be produced, and this gas may either be collected or suffered to escape, as may be thought expedient. The crude oil obtained, as already described, is purified in the following manner:—I put the oil into a cistern, and heat it (by a steam pipe or other means) to a temperature of about 150° Fahr. When thus treated, water and undissolved impurities contained in the oil will separate more readily from it than when cold, and the oil being left in a state of rest and kept warm for

about a day, many of those impurities will fall to the bottom of the cistern, and the oil may then be run off into another vessel, leaving the residuum behind. For distilling the oil the inventor prefers to use an iron still with a worm-pipe connected to it, passing through a refrigeratory apparatus, which is kept at or about the temperature of 55° Fahr., as already mentioned. The still is heated by a fire underneath it, which is kept up until the whole of the oil has been distilled over, and it will then be found that the still contains some dry carbonaceous residuum, which should be taken out before the still is again used. The oil is to be run from the condensing apparatus as it distils over into a leaden vessel, where, to each 100 gallons there are gradually added 10 gallons of the oil of vitriol of commerce. After this mixture has been well stirred for about an hour, it is to remain at rest for about twelve hours, so that the oil of vitriol and the impurities with which it has combined may settle at the bottom. The supernatant oil is then drawn off into an iron vessel, and to four gallons of a solution of caustic soda, of a specific gravity 1·300 (water being 1·000), added to each 100 gallons. The soda and oil are stirred together for about an hour, so as to neutralize any acid which may remain in the oil, and also take up any impurities capable of combining with it, after which the contents of the vessel are allowed to remain at rest for about six or eight hours, so that the solution of soda may subside, and then the supernatant oil is to be drawn off, and again distilled in the same manner as already described. Parafine oil obtained from the last mentioned distillation contains a fluid more volatile than parafine, a considerable portion of which may be separated from the oil and obtained in a separate state as follows:—The oil is placed in an iron still connected with a worm-pipe passing through a refrigeratory apparatus, and half its bulk of water being added, the contents of the still are boiled for about twelve hours, adding water from time to time, so as to keep about the same proportions of oil and water in the still.

The volatile fluid will pass over along with steam, and be condensed in the worm-pipe by the refrigeratory apparatus. This fluid will be clear and transparent, and as it is lighter than water, it separates, on standing, from the water with which it will be mixed as it leaves the worm-pipe of the still. This fluid may be burnt for the purpose of illumination, or applied to any other useful purpose to which it may be applicable. The last-named process will separate the greater portion of the volatile fluid from the oil, but a larger quantity may be separated by prolonging the operation. The oil left in the still after the completion of the process is then to be carefully separated from all the remaining water (upon which it will float) and conveyed into a leaden vessel, where two gallons of oil of vitriol are to be added to each 100 gallons. This mixture is to be well stirred for six or eight hours, after which it is allowed to stand undisturbed for twenty-four hours, in order that the vitriol may settle to the bottom of the leaden vessel, carrying with it all impurities with which it has combined. The supernatant oil is now to be drawn off into another vessel, and to each 100 gallons there is added 28 lbs. of chalk, ground up with a little water into a thin paste. The oil and chalk are to be well agitated until the oil becomes entirely freed from any trace of sulphurous acid, which may easily be known by heating a little of it

in a glass retort, and testing its vapors by moistened blue litmus paper. If the vapors change the color of the litmus paper to red, the oil must be treated with more chalk. This oil is to be kept warm—say at 100° Fahr.—in any convenient vessel for about a week, to allow impurities to settle, and it is then fit to be used for lubricating purposes, either by itself or mixed with an animal or vegetable oil, or it may be burnt by itself in Argand lamps for the purpose of illumination. To extract parafine from the purified parafine oil obtained in the manner described, the oil is to be cooled to a low temperature—say to 30° or 40° Fahr.; and the lower the temperature, the larger will be the quantity of parafine separated from the oil. In this way parafine is made to crystallize, when it may be separated from the oil by filtration through woollen or other cloths, and then squeezing it in a powerful press, by which means it will be made sufficiently pure to be employed for lubricating and some other useful purposes. But the parafine may be further purified, if required, by treating it several times, at a temperature of about 160° Fahr., alternately with its own bulk of oil of vitriol and with a similar quantity of a solution of caustic soda (of the specific gravity already mentioned) until the parafine ceases to render the oil of vitriol black. It is then to be washed in a weak solution of soda, and lastly with boiling water, until the water ceases to change the color of red litmus paper. Another method adopted to obtain parafine from parafine oil is, to put the oil into a still, and distil over one-half or more of its contents. The portion then remaining will contain a much larger proportion of parafine than the parafine oil at first put into the still contained; this residue being then distilled over into a separate vessel, and allowed to cool. Parafine may be separated by filtration and squeezing in cloths, and also purified by treatment with oil of vitriol and soda, as before described. Parafine oil from which parafine has been separated, as above described, still contains parafine in solution, and is suitable for lubricating or lighting purposes.

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*Method of Making Charcoal for Gunpowder.**

A committee appointed by the French Government, to examine and report upon a new method of making charcoal for gunpowder, has recently fallen under our notice, and as it may be interesting in these times, we shall lay a translation of it before our readers. There has been a powder manufactory of great celebrity at Esquerdes, in France, for several years. It was formerly conducted by M. Violette,† who adopted a mode of making charcoal by the emyloyment of water heated to a high temperature. The only objection to this process was its great cost. M. Gossart, his successor, conceived that he had discovered a method of obtaining the same result at a great reduction of expense, and it is this method which is reported on by the committee.

The apparatus, say the committee, proposed to be constructed at the

* From the Lond. Pract. Mech. Journal, August, 1855.

† See articles on M. Violette's steam preparation of wood, vol. i. p. 106. and vol. ii. p. 95.

powder mill of Esquerdes, is capable of converting about 220 lbs. weight of wood into charcoal at one time.

The water intended to be converted into steam is injected into the body of a pump, the piston of which is loaded with a weight slightly superior to the expansive force of the vapor.

The pressure of the piston forces the water upwards through a series of tubes placed inside one of larger diameter.

These tubes are intended to cool the gases and to condense the vapor after their exit from the carbonizing apparatus, the circulation taking place from above, downwards. The cold water contained in the tubes is gradually heated during its ascent, by means of the gas and vapor which pass through the outer tube. It is thereby brought almost to the temperature of ebullition, and is in part converted into vapor in a twisted tube arranged in such a manner as to cover the roof and walls of the furnace.

The water being vaporized in these tubes, is heated to a still higher temperature by being made to pass across bars of metal.

The vapor thus heated is conducted into a reservoir of cast iron provided with a thermometer and manometer to indicate its heat and expansive force. It is then passed into the carbonizing apparatus, from which the vapors and gases are conducted along the large tube already mentioned, where the vapor is condensed, and the gas, having been perfectly cooled, is thrown out at the bottom of the apparatus.

The air intended for the support of combustion is heated by passing round a portion of the wall of the chimney, and thus arriving in a heated state under the grate, heat is economized.

The advantages claimed for this system are the following:—

1. Only one furnace is required, in place of two, for the production of the vapor, and the raising it to a high temperature.
2. No more water is subjected to heat than is sufficient to produce the required quantity of vapor.
3. Much of the heat formerly lost is now utilized.
4. The employment of metal furnaces allows a greater heating surface to be obtained, at a low cost.
5. The production of heat is regular, and the temperature is regular also.
6. The products are capable of being compared one with another.

The arrangement for supplying hot air beneath the grate is a very beneficial one.

Finally, the proposed apparatus is reported to be ingeniously constructed, combining the advantages of economy and regularity in the manufacture of charcoal.

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*Steam Boiler Explosions.**

We have this month to direct attention to an unwonted increase in the number of explosions of steam boilers during the last few weeks. We give an illustration, representing the exact appearance of one of the boilers after the explosion which took place at Messrs. Adnit's Oil Mill, at

* From the London Artizan, August, 1855.

Chiswick, on Monday, the 16th of July; and we have taken some pains to obtain correct details of this case, otherwise than by collating the generally incorrect reports of the newspaper press.

There has been one explosion of a locomotive at Camden Town, a week previously to the above, recorded in the "*Times*" of July 14th. Another locomotive burst on the 2d July, on the South Yorkshire Railway, at the moment of its being detached from the train, by which the fireman is stated to have been blown high up into the air and killed. The explosion of the boiler of a steam tug at Shields, called the *Witch*, is also mentioned in the daily papers of the 13th July. Besides the above, the Manchester papers give us reports of other explosions in that vicinity; one, at a wood-turner's, in Blackfriars Street, Salford, by which the stroker, *fifteen years of age*, was killed, and the boiler, 11 feet × 3 feet diameter, $\frac{3}{8}$-inch thick, was projected through several thick walls to a distance of 90 feet from its bed. The same paper, the "*Manchester Times*," of June the 16th, gives us an account of an explosion occurring two days previously, of remarkable importance, from the eminence of the engineers' names connected with it. It was one of the celebrated Nasmyth's *upright* boilers, 25 feet long by 5 feet diameter, on the premises of the no less eminent engineers, Messrs. Beyers, Peacock, & Co., of Gorton, near Manchester. This boiler contained an inside chimney flue, *three feet in diameter*, made of $\frac{3}{8}$-inch plates, which *collapsed;* although it is stated that it was *calculated* to bear 100 lbs. per square inch pressure, and was working at 65 lbs. shortly before the explosion took place. If this statement is correct, it is perhaps fortunate for the gentlemen who made the "*calculation*" that no one was killed.

The marine boiler referred to above was working at the now prevaling system of very high pressure, toward which we appear to be infallibly drifting, the certain consequence of bad trade and low prices for engineering work.

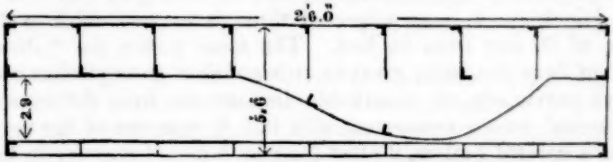
We have here, in as many weeks, examples of these deplorable accidents, as they are called, in each of the great departments of steam engineering—stationary, locomotive, and marine—calling loudly for a more adequate investigation, than the subject has perhaps yet received. They have certainly been, happily, not attended with many casualties, or loss of life to so great an extent as frequently happens, and therefore cannot excite that great and painful interest in the public mind which we sometimes witness. This circumstance is, however, a reason rather in favor of than against a scientific discussion of the subject at the present time, inasmuch as the exact state of matters just previous to and at the moment of explosion can generally be ascertained to a greater nicety before than after fatal consequences have ensued. The parade of coroners' inquests, and the possible verdicts for manslaughter, are to a certain degree preventives of that fearlessness in witnesses imperatively necessary to elucidate any scientific truth, involved in such conflicting hypotheses as this subject confessedly is.

In the Chiswick explosion above referred to, we have, happily, a *living* engine driver to testify to the fact of the explosion occurring at the very moment of his opening the stop-valve for starting the engine, instead of

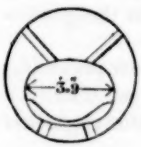
a *dead* man to be blamed by some eminent engineer for overloading the safety-valve.

Very many instances of explosions taking place at the time of starting the engine will occur to the readers of *The Artizan*, when one would naturally expect such a release to the confined steam would tend to diminish, rather than to increase, the pressure in the boiler.

Without adverting to the popular truism on all explosions—"the weakness of the boiler and the strength of the steam," and without speculating further on this Chiswick case at present, we may safely state that a slight inspection of our sketch will satisfy our engineering readers that the *oval shape* of the inside flue tube, and the small quantity of water over it, have had a good deal to do with the explosion.



The boiler was made by Messrs. Wilson & Co., of Leeds, about three years ago. It is 5 feet 6 inches in diameter and 26 feet long, and originally had the furnace fixed underneath, but not giving sufficient steam it was altered within the last nine months, by having an oval furnace tube, 3 ft. 9 in. × 2 ft. 9 in., with the furnace placed inside; the tube being stayed, as shown, through its whole length, by stays 4″ × ½″, which are now torn away from the rivets, and the top of the tube is collapsed and beat down within an inch of the bottom. The plates, for about 10 feet in length, over the furnace, are of Low-Moor iron. The safety valve was loaded to the average pressure worked with (20 lbs. on the inch) at the time the explosion took place, which was at about twenty minutes to one P. M., the workmen having just returned from dinner, and the engine-driver being in the act of opening the stop-valve to start the engine. It is considered fortunate by the proprietors that no loss of human life took place, although two horses were scalded to death.



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*Description of a Self-Capping Rifle.**

At a recent meeting at the Institution of Civil Engineers, M. Néron, of Paris, exhibited an ingenious mode of placing detonating caps on the nipple of a rifle or a musket. The apparatus consisted of a tube containing twenty-two caps, placed parallel with and close beside the barrel, being partially inserted in the stock, and so arranged, that whilst the near end was attached by a pin to the hammer, the further extremity was free to travel in a slot. Its action was very simple; the tube being filled with caps from a reservoir, several of which would occupy but a very small space, the end cover was turned down. On drawing the hammer to half-

*From the Lond. Civ. Eng. and Arch. Journal, February, 1855.

cock, the tube was drawn forward until a cap was brought over the nipple, and at full-cock the cap was pressed down upon it. After firing, if any portion of the copper remained attached to the cap, it was removed by a small picker preceding the tube on its being again drawn forward to repeat the operation. It was evident, that by this simple and cheap addition to any fire-arm much time must be saved in loading, and a great waste of caps must be avoided, whilst about twenty five per cent. of copper was saved in making the caps, and they were kept dry in the reservoir instead of being exposed to damp and running the risk of not exploding, as had occurred frequently in action on recent occasions in the Crimea. The system was stated to have obtained the approbation of the highest military authorities in France, and with the characteristic alacrity of the government of that country, to be already in process of adaptation to the Minié rifles and to fire-arms of all kinds for the army; it had only within the last few days been brought here to lay before the English government, and was submitted for the inspection of the Members of the Institution of Civil Engineers.

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*Dimensions of the New Iron Steamer Royal Shepherd.**

Melbourne and Launceston new iron screw-propeller steam-vessel "*Royal Shepherd.*" Built and fitted with machinery by Messrs. Blackwood and Gordon, iron ship-builders and engineers, Paisley, 1853.

Dimensions—Customs' Measurement.

Length on deck,	148 feet	1 tenth.
Breadth at two-fifths of midship depth,	19 "	8 "
Depth of hold amidships,	10 "	5 "
Length of poop,	36 "	6 "
Breadth "	16 "	7 "
Depth "	6 "	5 "
Length of engine room,	31 "	9 "

Tonnage.

Hull,	221 23-100	tons.
Poop,	44 07-100	"
Total,	265 30-100	
Engine room, 71 07-100	80 82-100	"
Shaft tunnel, 9 75-100		
Register,	184 48-100	"

Builders' Measurement.

Length of keel and fore-rake,	140 feet.	
Breadth of beam,	20 "	
Length of engine room,	31 "	11 inches.

Tonnage.

Hull,	272 32-94	tons.
Engine room,	67 82-94	"
Register,	204 44-94	"

A pair of oscillating engines of 50-horse nominal power; diameter of cylinder, 30 inches; length of stroke, 2 feet 6 inches. Screw propeller: diameter, 7 feet 2 inches; pitch, 10 feet 6 inches; has two blades. One tubular boiler: length, 10 feet 4 inches; breadth, 9 feet 2 inches; depth, 10 feet 6 inches. Three furnaces. 200 tubes: diameter, $3\frac{1}{8}$ inches;

* From the Lond. Artizan, July, 1855.

length, 6 feet 6 inches. Launched, November, 1853: draft of water, forward, 4 feet; ditto aft, 5 feet 7 inches: average speed, 10 knots an hour; consumes 7 cwt. of coals per hour; engines averaging 45 revolutions per minute. Has passenger accommodation in full poop. Sailed out to Melbourne, from the Clyde, under canvass, and is now plying in consort with the *Black Swan*, also built by the same firm, between Launceston and Melbourne, with goods, passengers, &c.; carries about 276 tons of cargo.

Description.—Three masts; barque-rigged.

*Dimensions of the Iron Steamer Anglesea.**

Liverpool, Bangor, Beaumaris, and Menaibridge new iron paddle-wheel steam-vessel "*Anglesea.*" Built and fitted with machinery by Messrs. Blackwood and Jordan, iron ship-builders and engineers, Paisley, 1855.

Builders' Measurement.	
Length of keel and fore-rake,	160 feet 6 inches.
Breadth of beam,	19 "
Length of engine room,	46 " 7 "
Tonnage.	
Hull,	289 29-94 tons.
Engine room,	90 21-94 "
Register,	199 08-94 "
Customs' Measurement.	
Length on deck,	160 feet 6 tenths
Breadth at two-fifths of midship depth,	18 " 6 "
Depth of hold amidships,	10 " 3 "
Length of engine room,	46 " 6 "
Tonnage.	
Hull,	245 29-100 tons.
Engine room,	96 61-100 "
Register,	148 68-100 "

One steeple engine (one piston rod,) of 60-horse nominal power: diameter of cylinder, 42 inches; length of stroke, 4 feet. Paddle wheels: diameter over floats, 16 feet 6 inches. 17 floats: length, 7 feet 6 inches; breadth, 1 foot 4 inches. Two tubular boilers: length at crown, 10 feet $9\frac{1}{2}$ inches; ditto at furnaces, 9 feet 11 inches; breadth, 10 feet 9 inches; depth, 9 feet. 560 cubic feet of steam and 794 cubic feet of water, when tubes are covered 9 inches. Six furnaces: length of fire-bars, 6 feet 2 inches; breadth, 2 feet 9 inches. Three furnaces in each boiler. 420 tubes, or 210 in each boiler: diameter, $3\frac{1}{8}$ inches; length, 6 feet 6 inches; having two funnels (bell tops;) diameter, 2 feet 10 inches; length, 21 feet. One boiler before and the other abaft the engine. Contents of coal-bunkers, 35 tons; frames, $3\times2\frac{1}{2}\times\frac{3}{8}$ and $\frac{5}{16}$ of an inch, spaced 18 inches apart; eight strakes of plates from keel to gunwale, tapering in thickness from $\frac{7}{16}$ to $\frac{5}{16}$ of an inch; three bulkheads. Averages 30 revolutions per minute. Was launched from the building yard at Cartvale, March 20th. Draft of water with machinery, &c.: forward, 5 feet 8 inches; aft, 6 feet 6 inches. The cabins are very tastefully fitted up, and ornamented with stained glass paintings, representing Welsh scenery, &c. The skylight is also ornamented with stained glass, and has a handsome and beautiful appearance. The figure-head is a Welsh female, in the national costume of the country. This vessel is capable of accommodating from 350 to 400 day passengers. The masts

* From the London Artizan, July, 1855.

are rakish, with wire rigging, giving the vessel a smart looking appearance.

Description.—A demi-female figure-head; no galleries; three masts; schooner-rigged; standing bowsprit; one main and quarter deck; square sterned and clincher built vessel: clipper bow. Owners, Messrs. Price and Case.

Port of Liverpool. Commander, Mr. John Hunter (late of the *Menai*).

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*Dimensions of the Steamer Corio.**

New iron screw propeller steam-vessel "*Corio.*" Built by Messrs. Scott and Co., iron ship-builders, Cartsdyke, Greenock; machinery by Messrs. Blackwood and Gordon, engineers, Paisley, 1854.

Dimensions.		
Length on deck,		99 feet 7 tenths.
Breadth at two-fifths of midship depth,		17 " 1 "
Depth of hold amidships,		9 " 3 "
Length of quarter deck,		25 " 4 "
Breadth " "		15 " 0 "
Depth " "		2 " 7 "
Length of engine space,		22 " 8 "
" shaft tunnel,		10 " 4 "
Breadth " "		3 " 3 "
Depth " "		3 " 6 "
Tonnage.		
Hull,		112 70-100 tons.
Quarter deck,		11 13-100 "
Total,		123 83-100 "
Engine space,	39 24-100	40 55-100 "
Shaft tunnel,	1 31-100	
Register,		83 28-100 "

A pair of inverted cylinder engines of 20-horse nominal power: diameter of cylinders, 20 inches; length of stroke, 1 foot 8 inches. Screw propeller: diameter, 6 feet 10 inches; pitch at centre, 12 feet 10½ inches; ditto at circumference, 14 feet 6 inches; has two blades. One tubular boiler: length at crown, 10 feet 2 inches; ditto at furnaces, 9 feet 7 inches; breadth, 6 feet 1 inch; depth, 8 feet 11 inches. No steam chest. Two furnaces: length, 6 feet 2 inches; breadth, 2 feet 2 inches. 86 tubes: diameter, 3 inches; length, 6 feet 6 inches. Chimney (bell top): diameter, 2 feet 7 inches; length, 20 feet 6 inches. Geelong, November 20th, arrived from the Clyde; was totally dismasted, and received other damage, in a gale which lasted from the 19th to the 29th of October, (during which time, the late commander, as also the steward, was washed overboard and lost.) Employed in the coasting trade of Australia; carries about 111 tons of cargo.

Description.—No figure-head or galleries; standing bowsprit; 2 masts; brig rigged; round sterned, and clinch built vessel; common bow.

Port of Greenock.

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*Her Majesty's New Yacht "Victoria and Albert."**

On looking over the "Navy List," the other day, we were very much struck with the fact that of all the vast naval armament now in course

* From the Lond. Artizan, July, 1855.

of construction, only *one* paddle-wheel vessel appears in that list, all the others being screws.

As it—the Royal yacht—may be the last of the *paddle* race in the Royal Navy, we have much pleasure in being able to give our readers the following particulars of this vessel.

The makers of the machinery are the Messrs. John Penn and Son, and from the high standing of this firm as marine engineers, we fully expect that this last example of the *paddle*, constructed for great speed, with all the necessary qualities of compactness and strength combined with lightness,—we say we fully expect that the machinery of this vessel will embody all the experience in marine engineering during the last thirty years, and prove highly creditable to the constructors.

There are four boilers, two placed before and two abaft the engines, with a funnel to each pair of boilers, and the stoke-hold amidships. The following are a few of the principal dimensions of the boilers :

Length of boiler, (athwartship,)		10 feet.	
Width of fire room, "		10 "	
Length of boilers (fore and aft) each,		21 "	9 inches.
Height "		14 "	6 "
Number of furnaces in each boiler,	6.		
Width "		3 "	2 "
Length "		6 "	6 "
Length of tubes, (brass ferruled,)		6 "	5 "
Diameter of ditto,			2½ "
Internal diameter of ferrules,			2 "
Number of tubes in the four boilers,	3024.		
Total fire-grate surface,	504 sq. ft.=84 per H. P.		
Total heating surface in flues and tubes,	14,059 sq. ft.=23·4 per H. P.		
Area through tubes,	9,493 sq. in.=15·8 per H. P.		
Pressure on the safety-valve,	20 lbs. on the square inch.		

On carefully looking over the above figures, we cannot but be struck with the very much more common-sense view taken by our engineers now-a-days.

We have often regretted to see, as we have often seen, vessels loaded with *large engines*, and on making the inquiry, "Have you plenty of steam?" "No," was the usual reply, and it is too often so still that the answer is, "*No, we are short of steam.*" And it cannot be denied, that the boiler, as the source of power, is too often lost sight of. This, however, cannot be said of the boilers of the Royal yacht.

The following are a few dimensions of the engines :—

Nominal horse power,	600 horses.
Diameters of cylinders, (vibrating,)	88 inches.
Length of stroke,	7 feet.

The paddle wheels are feathering and overhung, the outer bearing being supported on the ship side : each wheel weighs about 50 tons.

Diameter of wheel,	31 feet.
Number of floats,	14 in each wheel.
Size of floats,	11 ft. 6 ins. long×5 ft. 1½ ins. broad.

The vessel was designed in the Surveyor of the Navy's Office, and built at Pembroke Yard. As we saw her the other day, in the dock at Portsmouth, she looked a splendid specimen of modern naval architecture ; her internal fittings and accommodation are in every way

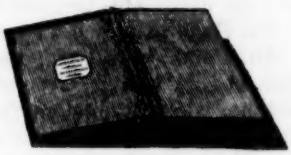
worthy of our beloved Sovereign, and an honor to the nation. It is expected that she will steam at about 16 knots per hour.

The following are a few of the principal dimensions of the vessel:—

Length between the perpendiculars, .	300 feet.
Breadth, extreme, . .	40 " 3 ins.
Mean draft of water, . .	15 "
Tonnage, builders' old measurement.	2342 tons.

Hinged Account-Book Covers. *

Messrs. Waterlow and Sons are now introducing a very valuable improvement in the manufacture of account books, charging no more for books on the improved than for those on the ordinary principle. A metal hinge, as shown in our engraving, is employed for fastening the inside of the book, to its cover, in the place of the linen joints ordinarily employed. By this improvement the inside of the book is entirely independent of the covers, and may be separated from them by the mere withdrawal of the sliding hinge-pin, so that one cover may be used for several books, or new covers supplied at pleasure to an old book, without the necessity of the book itself being placed in the hands of the binder. The great objection to the common glued joints is their liability to give way under the influence of a damp atmosphere; but with the improved hinge arrangement this is, of course, impossible. By the use of the metallic hinge, the pages of the book are allowed to lay quite flat, wherever it may be opened, an advantage which every accountant will know well how to appreciate.



For the Journal of the Franklin Institute.

On the Framing of Steam Engines.—Correction of Error.

Mr. Editor—In the July number of the *Journal*, is an article by T. D. Stetson, on the framing of steam engines, in which he ascribes to me the credit of designing the machinery of the steamer "*Knoxville.*"

His statement, in this particular, is incorrect, and does great injustice to Horatio Allen, Esq., who is entitled to the credit of all the peculiarities of said machinery. The inclined columns referred to were previously adopted in the steamer *Augusta*, designed also by Mr. Allen, and proved entirely satisfactory. Respectfully,

New York, September 13th, 1855. D. G. Wells.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, September 20th, 1855.

John Agnew, Vice President, in the Chair.

John F. Frazer, Treasurer.

George M. Conarroe, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

* From the Lond. Civ. Eng. Jour., April, 1855.

Letters were read from The Society of Arts, London: The Mechanics' Institute of the City of San Francisco; Thomas U. Walter, Esq., Washington, D. C., and the Kentucky Mechanics' Institute, Louisville, Ky.

Donations to the Library were received from The Austrian Engineers' Association, Vienna; The Smithsonian Institute; Thomas U. Walter and T. R. Peale, Washington City, D. C.; Honorable Joseph R. Chandler, U. S. Congress: The Legislature of the State of Pennsylvania, and Thomas D. Hart; Dr. L. Turnbull, Prof. J. A. Kirkpatrick, Prof. M. H. Bayé, and Henry Nolens, Philadelphia, Pa.

Donations to the Cabinets from Joseph Mascher, David W. Jayne, and George M. Conarroe.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement for August.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership of the Institute, from 4 gentlemen, were read and accepted.

Candidates for membership in the Institute, (7,) were proposed and the candidates proposed at the last meeting, (2,) were duly elected.

Dr. Rand exhibited a specimen of aluminium.

Dr. Rand also presented a mass of scale from Messrs. Pardee & Morgan, of New Haven, Connecticut, consisting almost entirely of carbonate of lime, which was taken from an iron cylinder twenty-eight feet long and two feet two inches in diameter, situated in a room over the boiler in which water is turned to steam. This cylinder is kept for warming water previous to entering the steam boiler, and rests on wooden supporters ten inches from the floor. The water is warmed by the application of steam on the top of the water which enters the cylinder through an iron pipe five inches in diameter. The scale was taken from the upper side of the cylinder just around the steam pipe. The water is taken from a well four to six feet from the surface of the ground and one hundred and fifty feet from the bank, which is washed by the waters of New Haven Harbor. It is about two years since this cylinder was cleaned, and there was never before a similar formation in it.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Abraham Masson's Steam Motive Power.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Steam Motive Power," invented by Mr. ABRAHAM MASSON, of Philadelphia, Pennsylvania—REPORT:

That this engine differs from that class usually denominated "Rotaries" in one essential particular, viz: that neither the piston nor cylinder revolves around the axis of the latter, nor around any line parallel thereto, so that the fundamental objection to rotary engines, usually so called, arising from leakage and unequal wear of packing, cannot be urged against this form of engine. It consists, in general terms, of four cylin-

ders whose axial lines are at right angles with each other and tangents at four points to a circle whose centre corresponds with that of the main shaft; the revolution of the four cylinders about this point, (producing revolution of the shaft to which they are attached,) is obtained by guiding the ends of the piston rods to a fixed involute curve or a curve eccentric with the main shaft. Three modifications of this engine have been designed. In the first plan, the curve is a circle, fixed eccentric with the shaft to which the cylinders are attached. In the second, two (or four) concave involutes are connected continuously and fixed so that their extreme points may be circumscribed by a circle concentric with the main shaft. Thirdly, a single involute forming one-fourth of a complete one is fixed, and the piston rods of each opposite pair of cylinders are connected together, so that the end of at least one of each pair shall be on the curve at any time.

1st. *Originality.*—The Committee understand from Mr. W. C. Grimes, of this city, that a device similar to the first of the three engines above named, was modelled by him some years since, and abandoned as not promising results of practical value. Of this they can speak only on his authority, not having access to the model. The other two forms of engine are, so far as they are aware, original with Mr. Masson.

2d. *Advantages.*—The principal advantage which can be claimed for this form of engine is, equality or uniformity of pressure during the entire revolution. This is, undoubtedly, an important one, but the Committee believe that the employment of two oscillating cylinders disposed on opposite sides of the same shaft, would produce an uniformity so nearly the same as Mr. Masson's engine, as to be considered such in practice, while in such arrangement the space taken up would be, in a line perpendicular to the shaft (and horizontally) not much greater; in the line of the shaft the same; and in vertical height materially less.

3d. *Disadvantages.*—The Committee consider the employment of four cylinders a complexity which would materially increase the expense and wear of the engine, and which would not be compensated for by the slight additional uniformity in motion. On the other hand, it is true, that the valve gearing is remarkably simple, consisting, as proposed by Mr. Masson, of a single ring on each side pierced with openings for the inlet and outlet of steam, pressing against bored cavities in the block containing the four cylinders, which, by their revolution, bring at the proper times, their own steam and exhaust openings opposite those in the ring.

Of the three forms of engine the Committee consider the first described to be the best, as by its use, the jar and wear incident to the other two would be avoided.

The Committee have endeavored to give Mr. Masson's plan all the consideration to which it is entitled, and, although their judgment of its practical value is rather unfavorable, they cannot close their report without remarking on the ingenuity displayed by Mr. Masson, not only in the original idea of such a plan of engine, but in developing it in its details.

By order of the Committee,

WM. HAMILTON, *Actuary.*

Supplementary Report.

Subsequent to the foregoing report, Mr. Masson has brought to the notice of the Committee another modification of the same principle, in which the chief objections previously made, appear to have been overcome. In this plan only two cylinders are used, their central or axial lines being parallel and equidistant from the centre of the shaft to which they are affixed; the piston rod ends are confined in a slot cut in a continuous double involute curve fixed in proper position, so that steam presses on one piston till after it has been admitted on the other, and there is always a pressure tending to revolve the shaft. The continuous curve presents no points at which the jarring alluded to in the former report can take place.

The Committee believe that this form of engine possesses such advantages as to simplicity and cheapness as would warrant its trial on a large scale. By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, September 13th, 1855.

Description and Drawings. By H. HOWSON, Civ. Eng.

A is the base plate of the engine, to which are secured the standards, B, having pedestals on the top serving as bearings for the main shaft, C. D D are two cylinders of exactly the same bore and placed parallel with each other: cast to these cylinders and serving to connect them together, is the circular hub or steam chest, F, and inside this chest is an annular projection, also cast to the two cylinders; the inside of the chest and outside of the projection being turned perfectly true with each other, and the projection being bored out for the reception of the shaft C, to which it is permanently secured. The top of the circular chest and the annular projection are faced so as to receive a suitable stationary cover, inside which is the stationary valve, G, of the peculiar form shown in fig. 3; the hub of the valve surrounding the projection, and its two edges bearing against the inside of the chest.

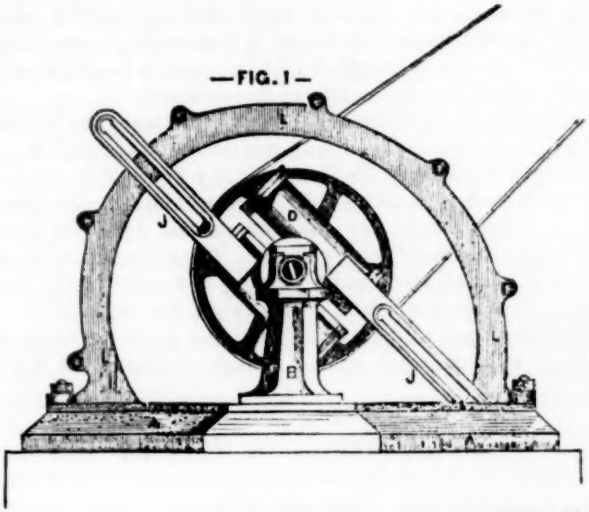
Each projecting portion of the valve is furnished with a wedge, I, so that on being forced by screws (too minute to show in the drawing) into a cavity formed for the purpose, the valve is caused to expand and fit tighter to the inside of the steam chest, when both shall have become worn and leaky through continual friction.

E is the steam pipe secured to the cap of the steam chest and communicating with the inside of the same on one side of the valve, and on the opposite side of the valve is the exhaust pipe. H H are two passages communicating with the interior of the steam chest and the ends of the cylinders D, the passage of one cylinder leading to the space on one side of the valve G, and the passage of the other cylinder to the space on the opposite side.

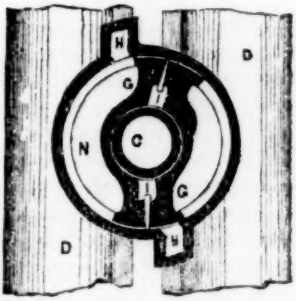
The cylinders are furnished with pistons having rods which project through stuffing boxes or covers, in the usual manner, the piston of one cylinder projecting in a contrary direction to that of the other. To the piston rods are secured the cross-heads K, which slide in the guides J, two of the latter being attached to each cylinder. Above the cross-

head the end of each piston is furnished with two rollers, one on each side, which are confined in the flanches of the curved ways L, the latter being connected to each other at intervals and to the base plate by suitable bolts.

—FIG. 1—



—FIG. 3—



—FIG. 2—

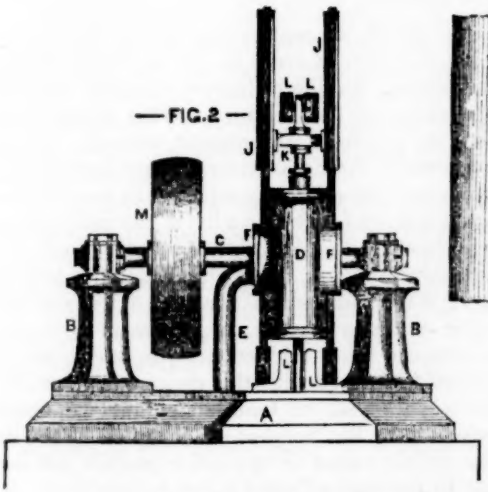


Fig. 1 is a front elevation of the engine.
Fig. 2 an end view of the same, and
Fig. 3 a sectional view of the valve apparatus.

It should be observed here, that the shape of the curved ways, is that of a double involute, which is preferred as the best curve adapted for the purpose.

The valve, G, is so arranged, in regard to the passages H, that the steam acts on the bottom of the piston of one cylinder only at a time.

As the engine is shown in the engraving so as to revolve from right to left, the steam is acting on the piston of the left hand cylinder, forcing the rod with its rollers against the flanches of the curved ways, L, and causing the two cylinders with their steam chest and shaft C, to turn with a force of the same intensity as though it was applied from a stationary cylinder to a crank whose length would be equal to the distance between the centre of motion and the centre of the cylinder.

There is this important difference, however, between the action of these revolving cylinders as combined with the curved ways and the crank as used in ordinary engines; in the former at any point of its revolution the force exerted is always at direct right angles, while in the latter, as all engineers are aware, the power is communicated during a greater part of the stroke at a disadvantageous angle. The cylinders with their piston rods and guides continue until arriving at a point in the double involute, when, through the action of the valve, the steam of the left hand cylinder becomes open to the exhaust and the pressure takes place on the right hand cylinder, and so the change continues as the machine revolves.

BIBLIOGRAPHICAL NOTICES.

Smithsonian Contributions to Knowledge, Vol. VII. Washington; Smithsonian Institute, 1855, 4to.

We are glad to see that the recent attempt to diminish or destroy the usefulness of the Smithsonian Institute, in order to use its funds for the support of a few indolent gentlemen in a life of literary idleness, has detracted nothing from the usefulness of the Institute, or the energy with which its important purposes are pursued. The present, seventh, volume of its contributions contains, besides the usual advertisement setting forth the purposes of the Institution and the means by which it is proposed to fulfil those purposes, and an appendix containing a list of the publications of learned societies and periodicals in the library, five articles of original investigations of a scientific nature; that is, if we admit that the longest article, On the Antiquities of Wisconsin, which occupies 95 pages and 53 plates, is, in any fair sense of the expression, an increment of knowledge among men. In one sense of the word it certainly is, and so would be the record of Mr. Tomkins' sufferings with the rheumatism, or Mr. Grundy's sensations under a paroxysm of tooth-ache; but we doubt whether this is the sense intended by Mr. Smithson or accepted by the interpreters of his will. The article before us appears to contain nothing in any way more interesting to the mass of mankind or to any particular class of it, and if Professor Henry will accept for publication all the lucubrations of equal value, which are sent for publication to our various societies, there will certainly be no quarreling about surplus funds. The opinion of those who take the most interest in this subject of American antiquities, appears to be nearly unanimous that the article possesses no novelty or intrinsic value sufficient to re-pay the cost of publication or the

labor of reading it, and we should come to the same conclusion from a mere inspection of the wood cuts of articles which are common in the most juvenile collections of Indian antiquities. With the exception, then, of this article, each of the contributions to the present volume present matters of considerable interest to us. The first is "An Account of a Tornado near New Harmony, Indiana, with a Map of the Track, &c. By John Chappelsmith. In this short paper, Mr. C. has given a brief account of a tornado and presented a general map of its course, together with a detailed plan of the most interesting part of its region, and drawings of the phenomena, the whole intended to supply facts, so much wanted for the determination of the truth of the various hypotheses proposed to account for these meteors. The conclusions of Mr. C. are unfavorable to the idea of a whirl of any kind, but lead him to the belief in a centripetal blow towards an uprising central column. His essay bears the marks of care and patient research, and, although we cannot agree entirely with his conclusions, we are not the less thankful to him for a very considerable and reliable increase of our knowledge on this interesting and much vexed question. It is, we think, worth remarking, that if any credit be given to the agreeing testimony of several witnesses as to the appearance of flame in the cloud, it must go very far to support Dr. Hare's, otherwise very probable suggestion of an electrical cause for the phenomenon. Following this paper is one by Professor Bailey of West Point, describing and figuring in very elaborate and neatly executed plates, a number of microscopic forms from various localities between California and Nova Scotia. The article is, for the most part, merely technical, but contains some remarks in relation to such forms as applied as tests for the excellence of microscopes which will be interesting to a large class of our community who are beginning to take great interest in this instrument. Dr. Leidy's Memoir on the Extinct Sloth Tribe of North America, is also a technical paper on palæontology, which will, we are sure, be very acceptable both here and abroad to the students of this branch of science.

Besides the merit of the papers, the plates in these volumes give evidence of the very important assistance giving by the Smithsonian Institute to the art of engraving, by affording encouragement to a style and finish which has been heretofore too rare in our country. The plates in the present volume, from the precision and minuteness required, present great difficulties both in execution and printing, and are, we think, equal to any executed abroad.

A Treatise on Pneumatics, being the Physics of Gases Including Vapors. By MARTIN H. BOYE, M. D., A. M.; Philadelphia, E. C. & J. Biddle, 1855: 12mo. pp. 116, & 12 pp. Tables.

This is a very valuable contribution to our works of popular science, by the Professor of Natural Philosophy and Chemistry in our High School, whose name is already familiar to all whose attention has been turned to chemistry, as an analytical chemist of uncommon merit. We insist in denominating the work one of popular science, although the author in